Vol. 10, No. 8

AUGUST, 1955

AGRICULTURAL CHEMICALS

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Residue Calculations

Fertilizing Crop Residues

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Mixed Fertilizer Plant

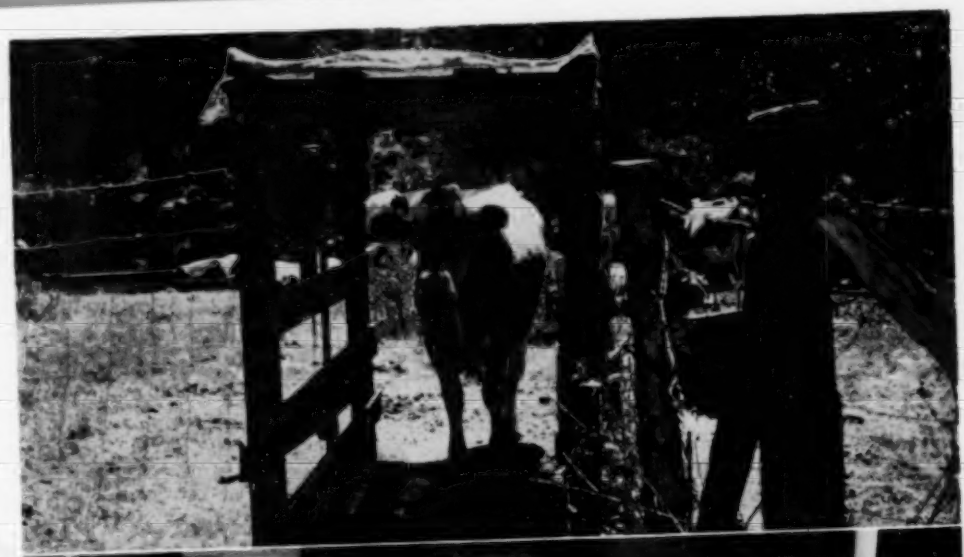
Battelle Institute

The Cotton Leaf Worm

Chemicals for Agriculture

Urea Fertilizers

Livestock Pest Control





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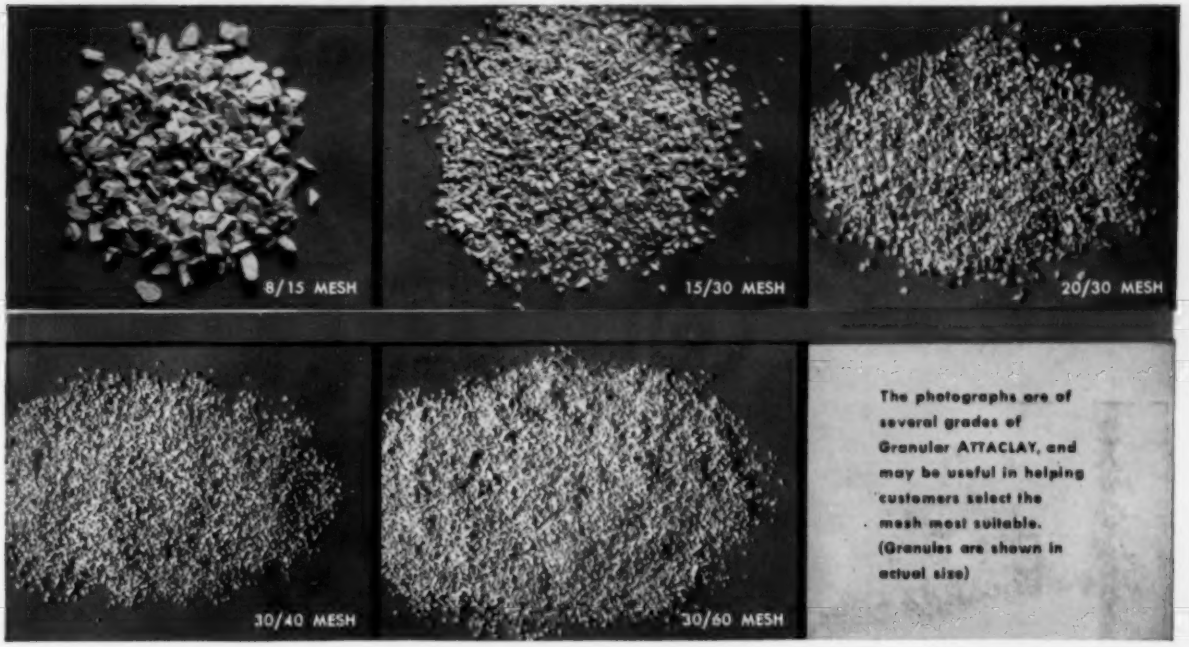
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AGRICULTURAL CHEMICALS



A Monthly Magazine For the Trade

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This Month's Cover

Top photo: Treadle-operated livestock sprayers are a convenient self-treating means of applying repellents or insecticides; bottom photo: application of water sprays provides protection from biting flies for long periods. See story Page 53.

Photos Carbide & Carbon Chem. Co.

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- (WRITE FOR BULLETIN A-1)

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Four ounces to one pound PERMA GREEN IRON 135 per tree produces dark green leaves and more, larger and better colored oranges.

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PERMA GREEN IRON 135 is an organic chelate that moves upward with the sap to rejuvenate the entire plant.

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SUNFLOWERS

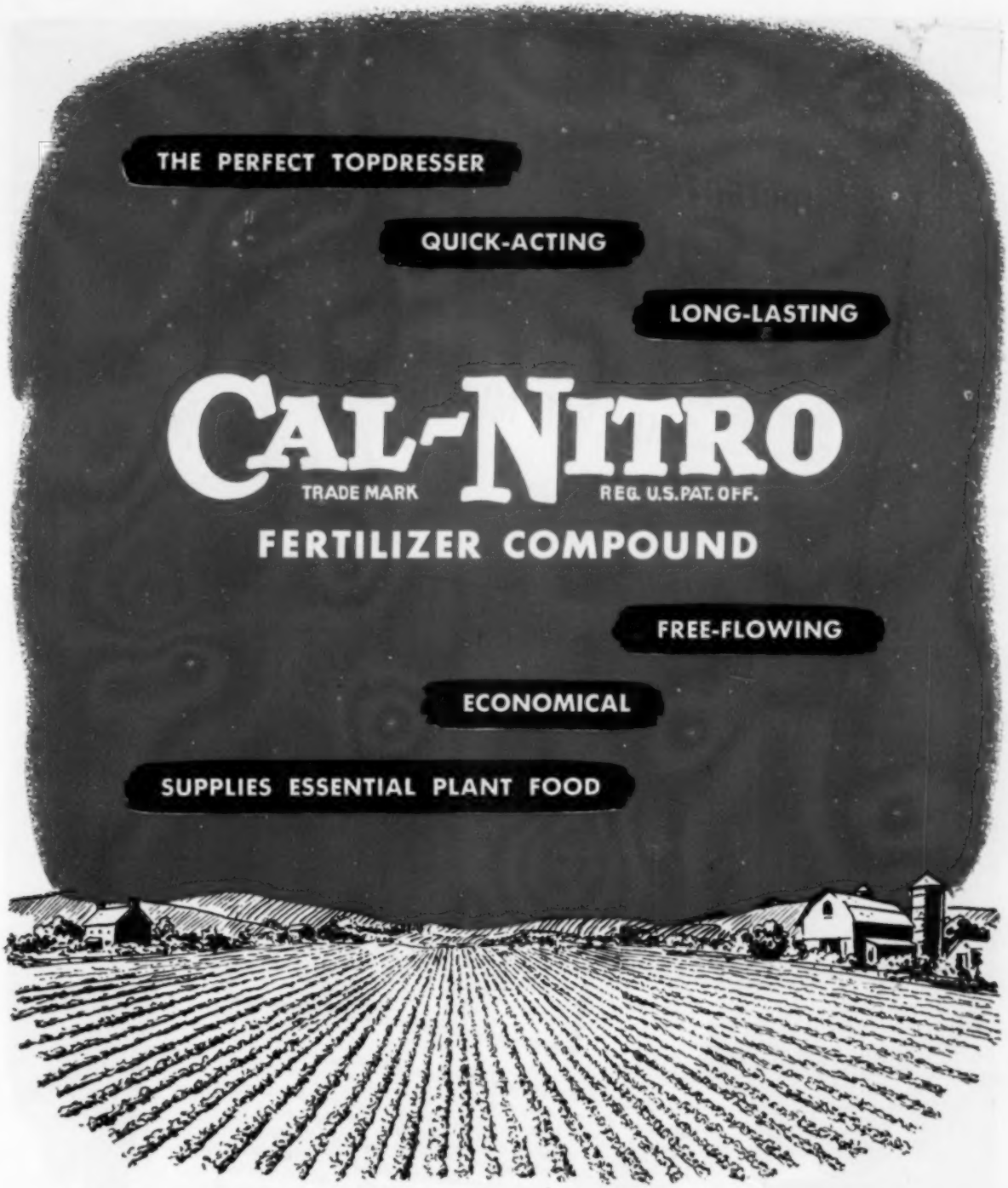
Grown in nutrient solution. Small yellow plant at left treated with iron sulphate.

Large dark green plant at right treated with PERMA GREEN IRON 135.



GARDENIAS (Greenhouse)

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RAYMOND ROLLER MILL showing cross-section of double whizzer separator unit. It is operated by an individual motor through a variable speed transmission.

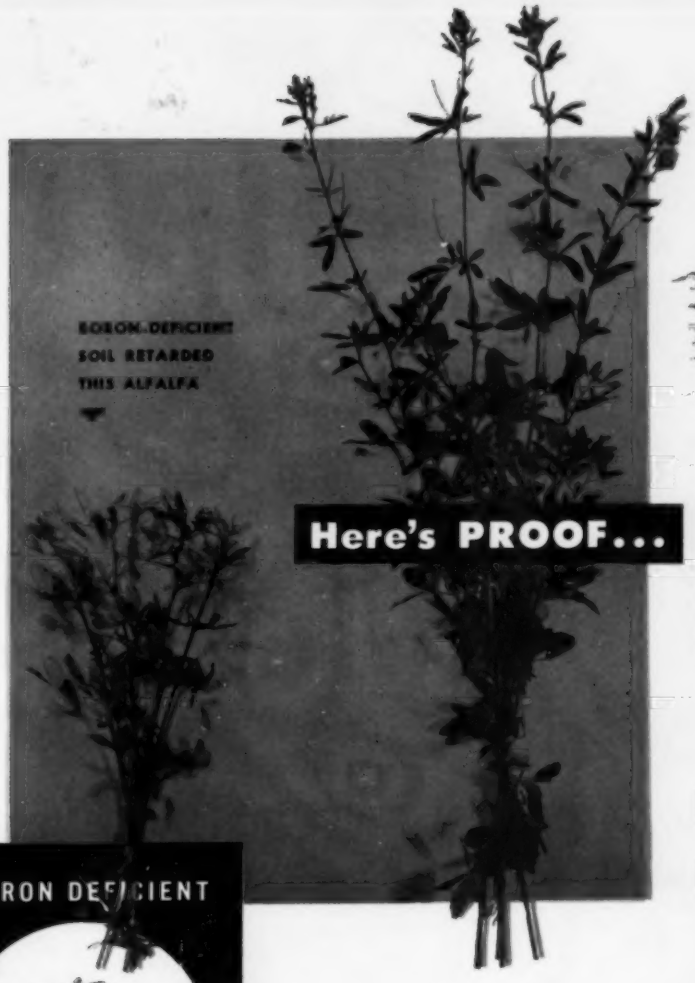
For detailed information on Raymond Mills for insecticide grinding, ask for Bulletin #68.

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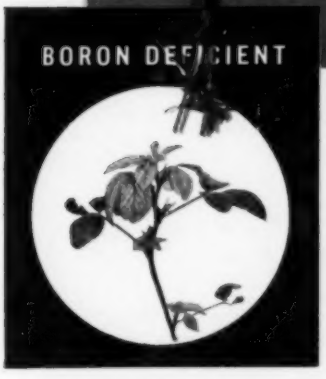


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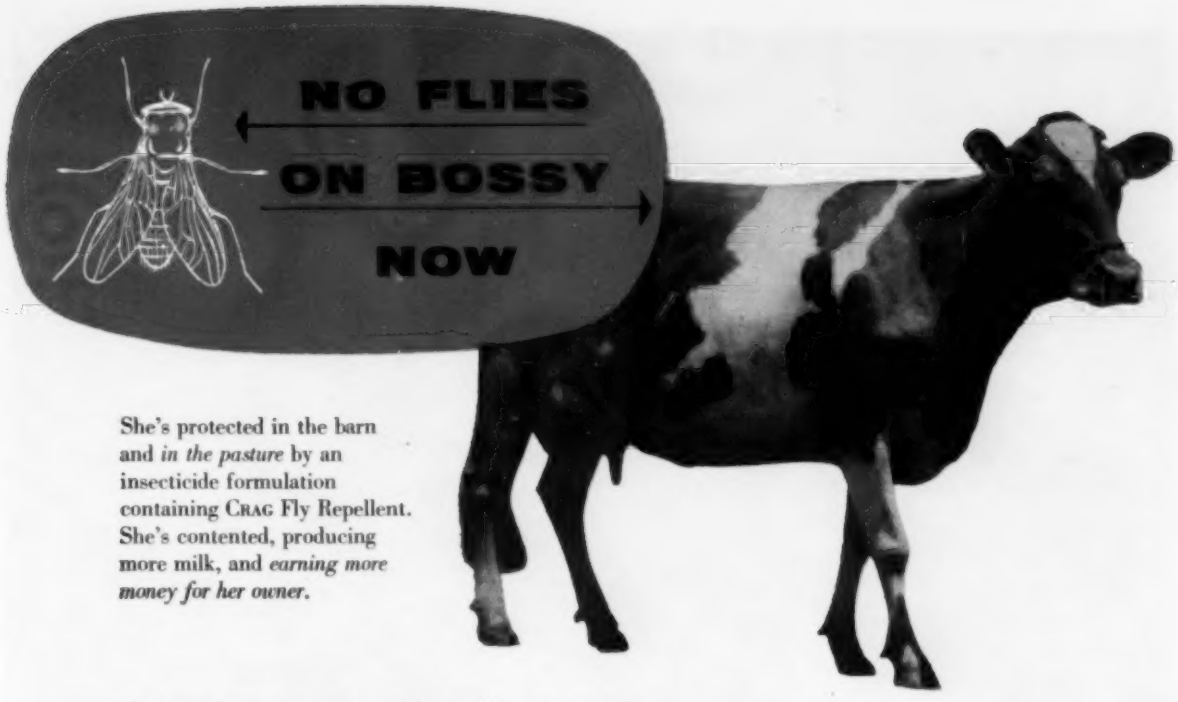
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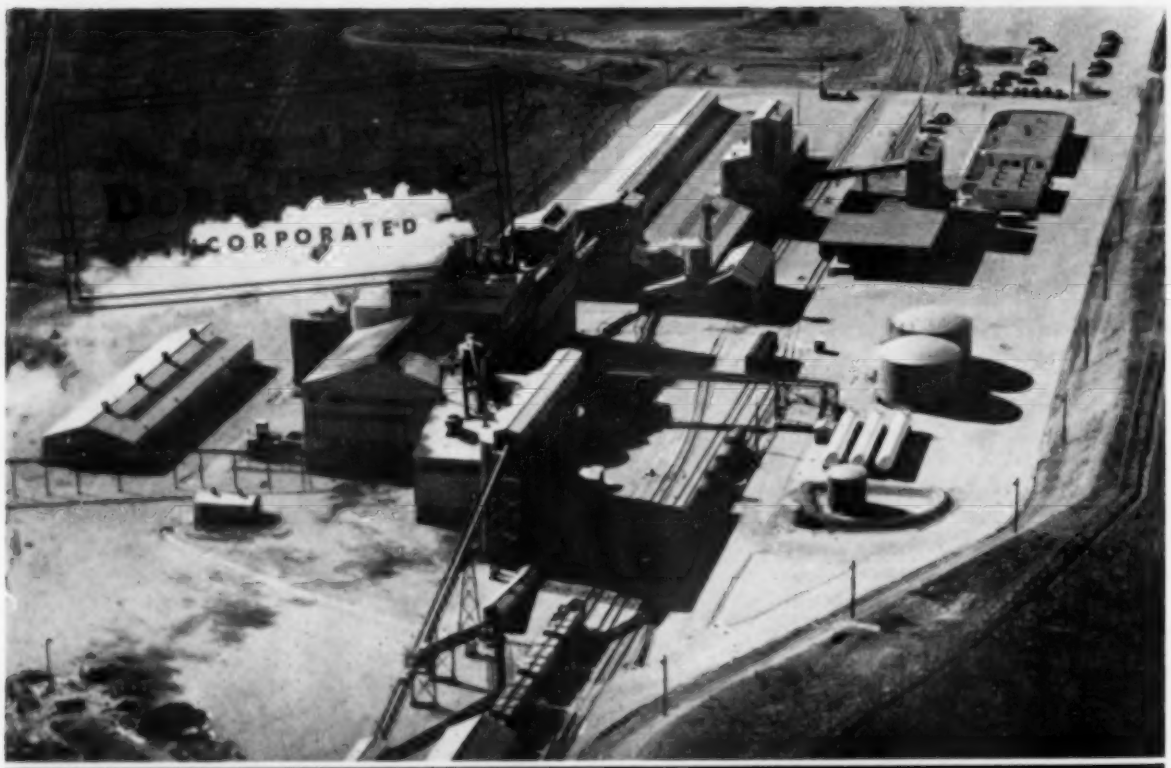
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If you are considering entering the fast-growing chemical fertilizer field — or if you plan to expand present facilities — it will pay to check with Dorr-Oliver.



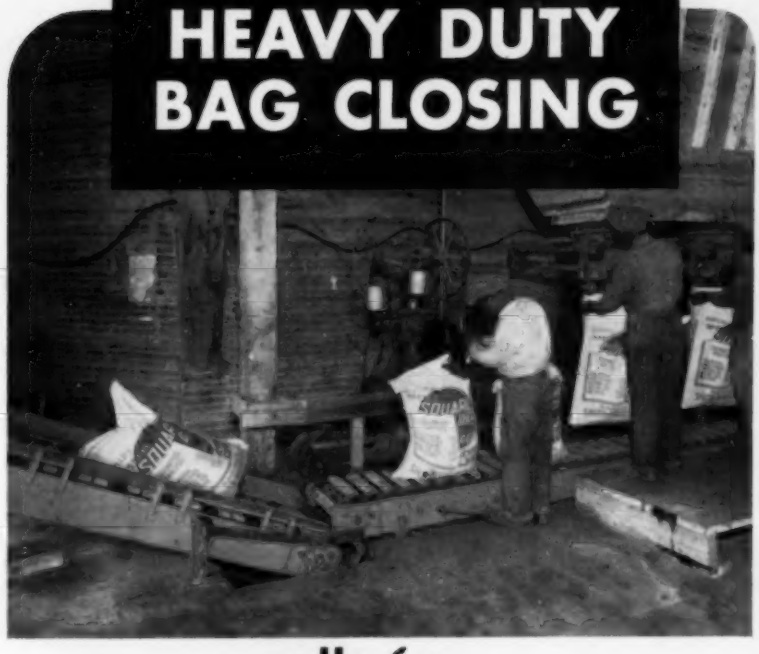
Free-flowing granules . . . important characteristic of high analysis chemical fertilizers produced by Dorr-Oliver designed plants.



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complete ammoniation

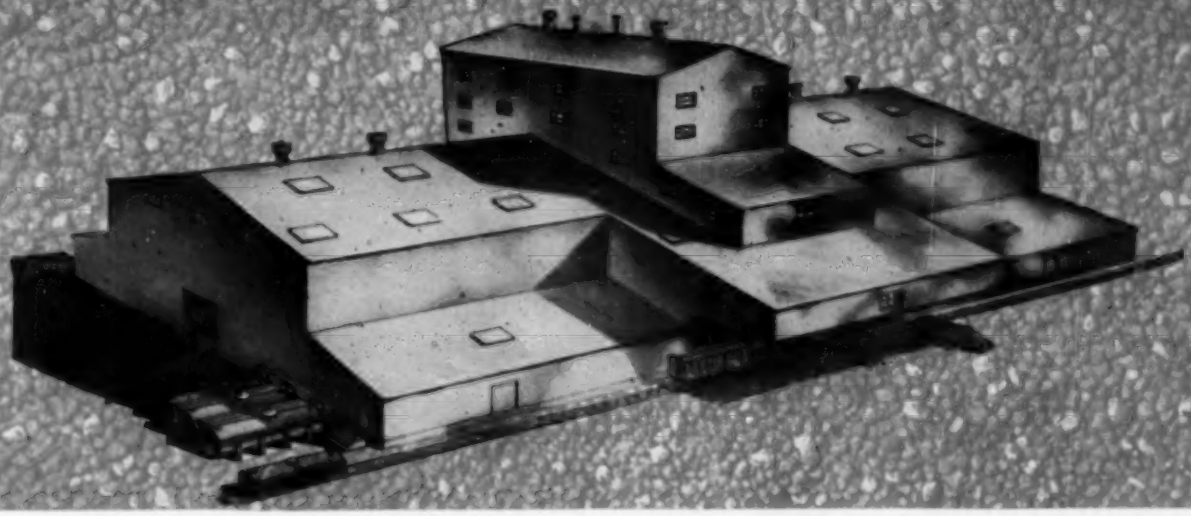
ONE look shows you why International's new Triple Superphosphate offers such a big advantage in ammoniation. Its improved fineness of texture; uniform, dust-free particles; and correct chemical structure assure maximum ammoniation in minimum time — help cut your manufacturing costs. International's new Triple Super is made by an improved process from high quality rock. Result: a high analysis product (46% A.P.A. or better). Special conditioning before shipment helps prevent setting up en route. This, plus improved particle size, means less grinding before mixing, more economical handling, better texture in your finished products and high product performance. International's new Triple Super is ready for immediate delivery to your plant. Write or wire the Phosphate Chemicals Division for samples and quotations.



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Superphosphate and mixed goods producers are invited to get our seasoned counsel on their expansion and modernization programs. It is available at no cost.

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LION IS HELPING YOU
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Impressive, Big-Space Advertisements are Appearing Month-After-Month in all These Publications

Lion's Chemical Sales Division is working to make sure you, as a fertilizer mixer, sell more fertilizers. One way we help is by consistent advertising to dealers and farmers. This advertising emphasizes how plant foods can best serve the farmer by increasing his profits.

We also offer One-Stop Service—which means you can contract for your nitrogen requirements from a single dependable source, saving you time (which, these days, is money!). As for *quality*, you can build your own reputation on a solid basis when you depend on Lion quality.

And when you need assistance with a formulation problem, our skilled Lion technical staff is ready to help you.

Our great storage facilities and the variety and flexibility of our manufacturing operations assure you of prompt shipment.

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Lion Anhydrous Ammonia—For formulation. A uniformly high-quality basic product. Nitrogen content, 82.2%.

Lion Aqua Ammonia—For formulation or acid oxidation. Ammonia content about 30%. Other grades to suit you.

Lion Ammonium Nitrate Fertilizer—For formulation or direct application. Improved spherical pellets. Guaranteed 33.5% nitrogen. Flows freely, spreads evenly.

Lion Nitrogen Fertilizer Solutions—For formulation. Three types to suit varying weather and manufacturing conditions.

Lion Sulphate of Ammonia—For formulation or direct application. Uniform, free-flowing crystals. Guaranteed to contain a minimum of 21% nitrogen.

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CHEMICAL SALES DIVISION

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Phosphatic Fertilizer Solution

California Formulator Blends Monsanto's Solution with Aqua Ammonia to Make Neutral 8-24-0 for Direct Application



Mounted behind cutting blades for protection, slender hoses carry liquid 8-24-0 from tank into soil as fast as it is broken.



Side-dressing eight rows of carrots at a time is simple chore for this rig. Note twin tractor-mounted tanks for carrying 8-24-0 used by this fertilizing contractor. Formulator also sells direct to farmer, and does fertilizing on contract.



Fertilizer tank follows wide-spread drill rig. Set-up is particularly well suited to preplanting fertilization which may take place in either spring or fall in Sacramento-Imperial Valley-San Joaquin area where much of the 8-24-0 is sold.



New-type liquid fertilizer drill and tank arrangement gets trial. Formulator maintains sizable test area for trying out new liquid fertilizer applicators, and to observe results of various liquid fertilizer formulations on crop response.



Giant drill rig covers a lot of ground fast, gets through matted surface of field to inject 8-24-0 into root zone. Side mounting of these fertilizer tanks makes it possible to carry a full day's supply without delays for refilling.



8-24-0 is used on all varieties of crops. Here's a set-up that's ideal for applying it in close row work. The large fertilizer tank is mounted out of the way in the rear. Fertilizer drills located in front help driver guide tractor.

Photographs courtesy Bree Chemicals, Inc.

Formulator's customers don't need potash, so company makes 8-24-0. If your trade calls for a complete soluble fertilizer, Monsanto has the right ingredients:

Diammonium Phosphate	(21.0-53.8-00.0)
Monoammonium Phosphate	(12.2-61.6-00.0)
Phosphatic Fertilizer Solution	(00.0-54.5-00.0)
Dipotassium Phosphate	(00.0-39.9-53.0)
Monopotassium Phosphate	(00.0-51.6-34.2)

These compounds are highly concentrated—cost you less to store and handle. They're pure—give you extremely close control of formulation. And—your supply is assured by Monsanto, world's largest producer of elemental phosphorus. Write now for booklet "Concentrated Water Soluble Fertilizers" to MONSANTO CHEMICAL CO., Inorganic Chemicals Division, 710 N. 12th Boulevard, St. Louis 1, Missouri.

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FERTILIZING

should mean RECORD Ammonium Sulphate sales

. . . Get Ready!

• This year fall application of USS Ammonium Sulphate should be greater than ever before. Not only because agricultural colleges and state experimental stations have proven FALL application of ammonium sulphate a practical way of supplementing nitrogen in the soil . . . but because the farmers themselves realize that this ammonia-type nitrogen carrier can be applied during fall and winter months, when they have more free time, and it won't leach out during the winter. This means that in the early spring, the nitrogen that crops need is already in the soil . . . ready to go to work. Farmers have seen the result of fall treatment with USS Ammonium Sulphate in bigger, more profitable crops on their own farms.

To help *your* sales, we are running 25 ads in 11 different farm magazines reminding nearly two and a half million farmers of the advantages in applying USS Ammonium Sulphate during the fall months. They will be looking to your FERTILIZER DEALERS to supply ALL they need WHEN they need it!

Send for these free sales boosters!

To help your fertilizer dealers sell more USS Ammonium Sulphate, United States Steel has prepared four FREE folders and newspaper mats in one and two column sizes promoting fall use of ammonium sulphate. They will add the personal touch to this BIG national promotion. Make certain each of your dealers has a supply of folders to hand out to his farmer-customers. Encourage him to use the newspaper mats in his local newspapers. It will mean bigger sales than ever *for you* and *for him!*

Don't be caught short during the big demand period. Order your supply of USS Ammonium Sulphate . . . send for your supply of sales boosters . . . do it TODAY!

USS AMMONIUM SULPHATE

Clip and Mail

Room 4821, Agricultural Extension
United States Steel, 525 William Penn Place
Pittsburgh 30, Pa.

Please send me, free:

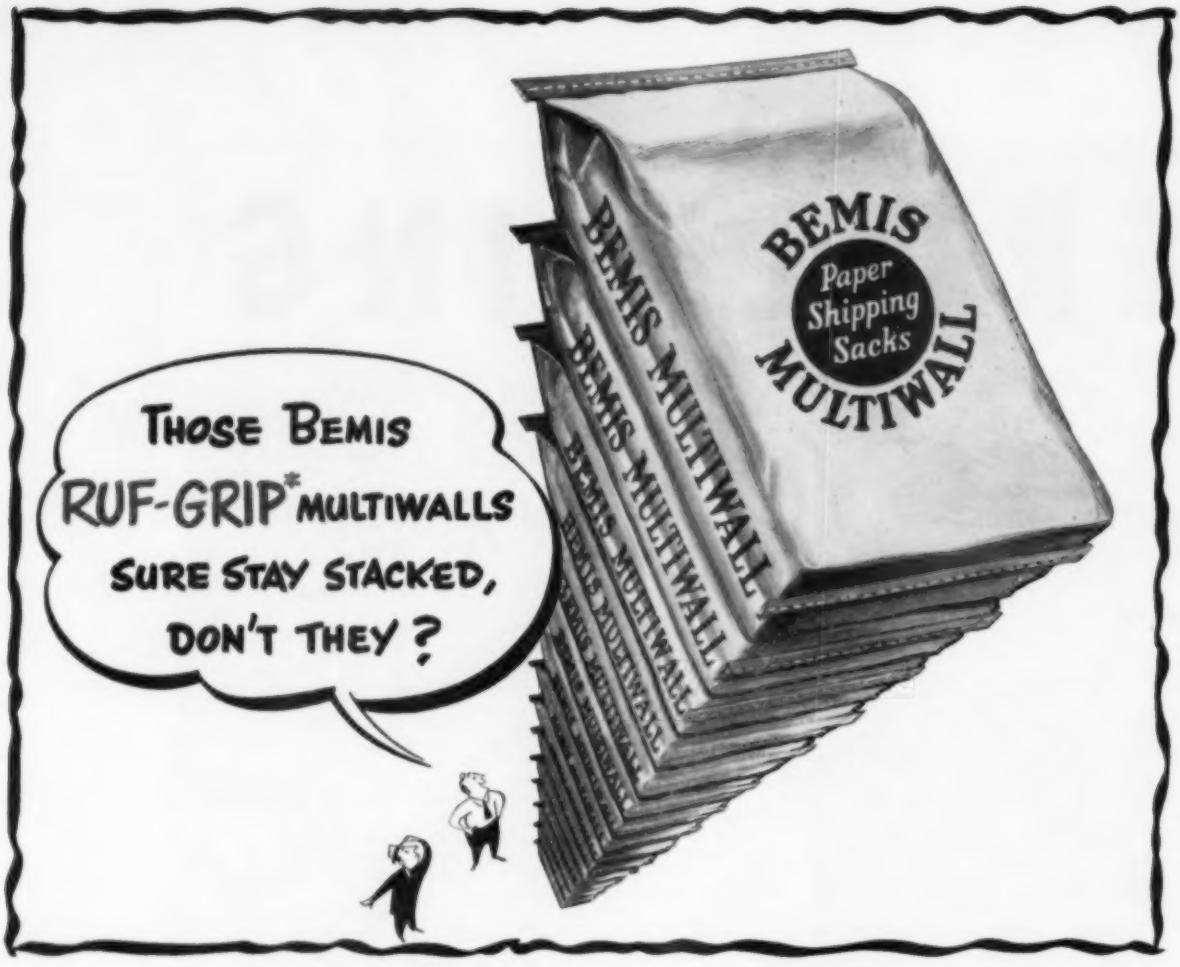
..... of each Ammonium Sulphate folder, ...one column mats
..... two column mats. (fill in number desired.)

Name .....

Address .....

City ..... State.....

UNITED STATES STEEL



Bemis Multiwalls made with RUF-GRIP kraft handle easily...and stack easily... and stay stacked. Consequently, they ship and store better. Get the details from your Bemis Man.

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Also in the Bemis Family, Serving the Fertilizer Industry...

Burlap Bags

Cotton Bags

Waterproof (Laminated) Bags

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Meeting Calendar

Aug. 1-5 — National Shade Tree Conference, 31st annual meeting, Mar Monte Hotel, Santa Barbara, Calif.

Aug. 8-10—North Central Division American Phytopathological Society, Wooster, Ohio.

Aug. 9-10 — Ohio Pesticide Institute Meeting, Wooster, Ohio.

Aug. 9-12—Rocky Mountain Conference of Entomologists, Cameron Pass 4-H Club Camp, Gould, Colo.

August 10 — Kentucky Fertilizer Conference, Guignol Theatre, University of Kentucky, Lexington

Aug. 15-19 — Annual Meetings, American Society of Agronomy and the Soil Science Society of of America, California College of Agriculture, Davis, Calif.

Aug. 16 — Connecticut Agricultural Experiment Station, Field Day, Mt. Carmel, Conn.

Sept. 5-9 — American Institute of Biological Sciences, Michigan State University, East Lansing, Mich.

Sept. 7-9—National Agricultural Chemicals Assoc., Annual meeting, Spring Lake, N. J.

Sept. 7-9 — Beltwide Cotton Mechanization Conf., Texas A&M College

Sept. 13-15, Western States Garden Supply Trade Show, Oakland, Calif.

Oct. 11 — Western Agricultural Chemicals Association meeting, Claremont Hotel, Berkeley, Calif.

Oct. 17-21 — National Safety Congress & Exposition, Chicago, Ill.

Oct. 18-20 — Entomological Society of Canada, Fredericton, B.C.

Oct. 27 — Middle West Soil Improvement Committee, annual business meeting, Sherman Hotel, Chicago.

Nov. 2-3—Pacific Northwest Plant Food Assn. Pilot Butte Inn, Bend, Oregon.

Nov. 3-4—Northeastern Division American Phytopathological Society, Springfield, Mass.

Nov. 4 — Fertilizer Section, South Carolina Annual Accident Prevention Conf., Hotel Francis Marion, Charleston, S. C.

Nov. 7-8—California Fertilizer Assoc., 32nd annual meeting, Hotel Mark Hopkins, San Francisco.

Nov. 17-18 — Nitrogen Solution Field Day, State Armory, Springfield, Ill.

Nov. 28 - Dec. 1 — Entomological Society of America, Annual Meeting, Netherlands Plaza, Cincinnati.

Dec. 5-7 — Agricultural Ammonia Institute, Kansas City, Mo.

Dec. 15-16—Beltwide Cotton Production Conference, Hotel Peabody, Memphis, Tenn.

Dec. 28-30 — American Phytopathological Society of America, Univ. of Wisconsin, Madison, Wisc.

Jan. 4-6—Weed Society of America, Hotel New Yorker, New York City.

Jan. 10-11 — North Carolina Pesticide School, Raleigh, N. C.

Jan. 16-18 — N. W. Vegetable Insect Control Conf., Imperial Hotel, Portland, Ore.

Jan. 18-20 — Western Cooperative Spray Project, Imperial Hotel, Portland, Ore.

Jan. 24-26 — Midwestern Garden Supply Trade Show, International Exposition Hall, Chicago.

Feb. 15-17—California Weed Control Conf., Sacramento & Davis, California.

Aldrin
Aramite
BHC DDT DDD
Captan
Chlordane
Dieldrin
Endrin
Heptachlor
Lead Arsenate
Lindane
Malathion
Methoxychlor
Ovex
Parathion
Sulphenone
Sulphurs
Systox
TEPP
Toxaphene

Seed Protectants
Herbicides
Soil Fumigants
Grain Fumigants
Defoliants
Cattle Sprays
Cotton Dusts
and other
Agricultural Chemicals

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Q. What do formulators and manufacturers require?

A. *Dependable* chemicals in *continuous* supply!

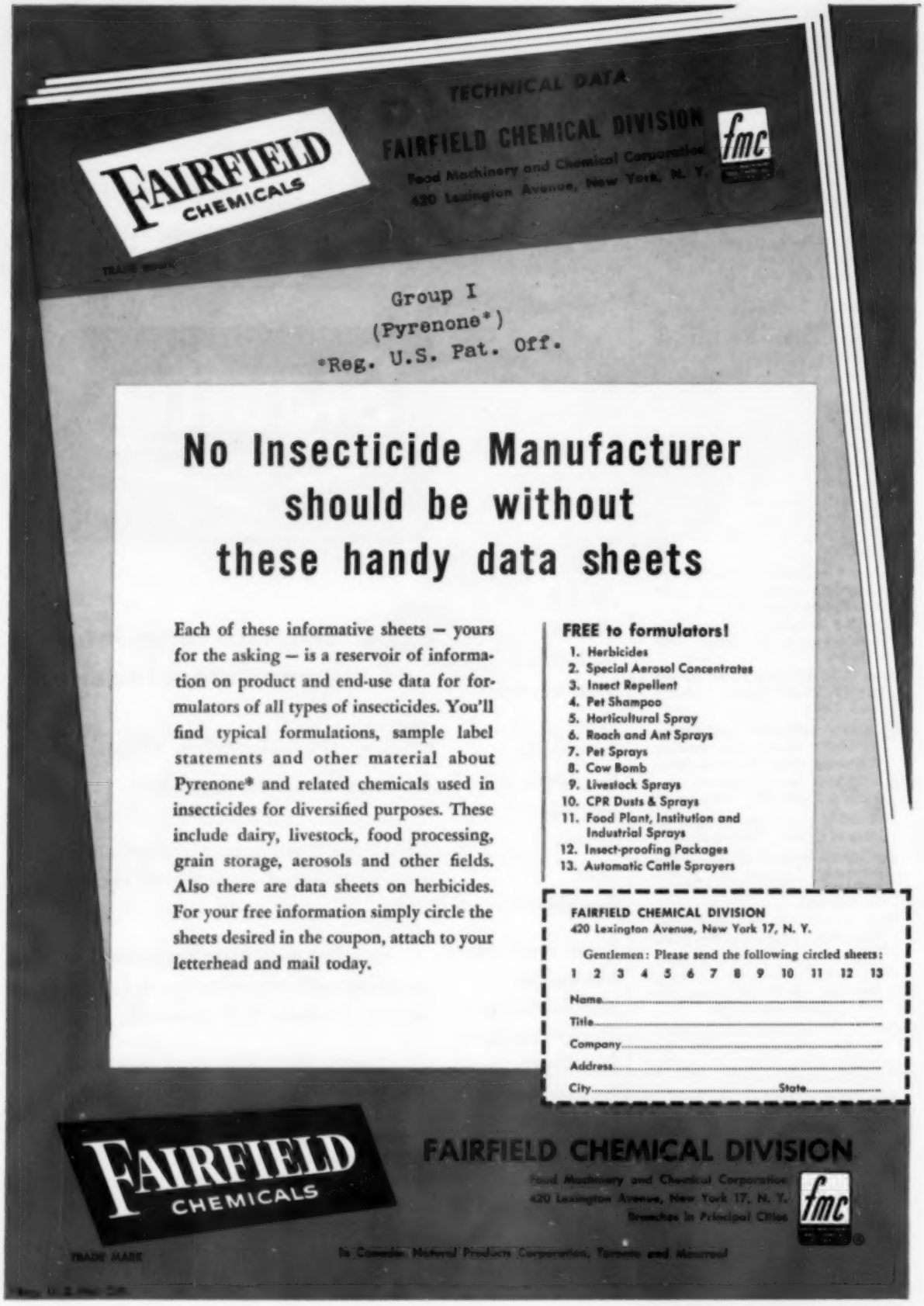
STAUFFER'S wide range of technical and formulated agricultural chemicals . . .

. . . coupled with *long* experience in *working with* manufacturers, formulators, packers, and growers . . .

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Editorial
COMMENTS

HOW well does application of agricultural insecticides pay? According to one well informed authority, Richard R. Messing of Arthur D. Little, Inc., in a recent talk before the Chemical Market Research Association, in New York (see pgs. 47-49) the return to the farmer on each dollar invested in insecticides amounts to something between five and twenty dollars. If these figures are accurate, this is certainly a ratio which demonstrates a tremendous further potential for increased use of pesticidal aids to crop production.

Such figures as these accent once more the opinion that the insecticide industry has only scratched the surface with its past and present sales and sales promotion policies. Farmers may have been hard to sell thirty years ago, but they have learned things over recent years, and today are, by and large, pretty smart business men. They are perfectly willing to spend a buck to save ten or twenty. They can be sold, but quite understandably they want the facts.

With few exceptions, the insecticide industry has not done this good selling job, either individually or collectively. The first step would be to really document the figures which Mr. Messing has quoted. Work has been done along this line, we know, down at North Carolina State College, but we have yet to see the comprehensive data which would be needed to support a solid claim and build a convincing case,—figures for various crops in different areas, for different seasons, rates of return from differing types and dosages of insecticide. This preliminary work, expensive and time-consuming though it may be, would seem to be a pre-requisite before the insecticide industry can marshall an impressive case. Then comes the even more costly and lengthy job of selling the bill of goods to the farmer, — convincing him through education and demonstration, repeated time after countless time, that insecticides give a multiple dollar return for the money invested in them.

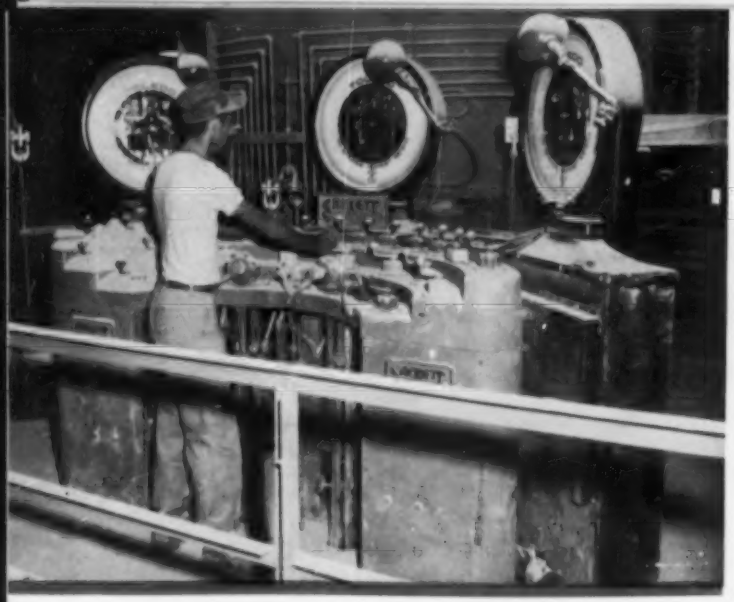
The fertilizer industry has made intelligent and sales productive use of such data, — helping the farmer to help himself. When the insecticide industry gets around to spending part of the time, energy and money they now spend on competitive selling in some such unified industry program designed to expand the entire pesticide market, perhaps today's price and profit picture may change for the better.

* * * *

THIS same speaker made a number of interesting predictions as to the future of the fertilizer business. He predicts continuing expansion in fertilizer consumption, for as he notes, only about 25% of the country's total crop land currently receives any fertilizer, and even in fertilized areas average usage remains well under optimum recommended rates.

He predicts increased use of nitrogen solutions, further progress in use of high analysis materials, a continuing trend toward higher nitrogen and potash content in the average plant-food ratio, perhaps eventually leveling out at a 1-1-1 basis, increased use of separate fertilizer materials as against mixed fertilizers, in-

(*Turn to Page* 81)



Mechanization reduces labor, time in preparing fertilizer formulations at



Top photo: (figure 1) Automatic batching operation. One operator manupulating controls can handle up to 24 materials.

Bottom photo: (figure 2) Rotary mixer, two-ton capacity, by Worthington Corp.

FLORIDA is perhaps unique among all the states in the multiplicity of fertilizer formulations required by its soil conditions and the great variety of crops grown. Some estimates indicate the total number to exceed 500 in one year. This creates a difficult situation for the local fertilizer manufacturers and particularly for the larger producers who distribute beyond the communities in which they are located. Of course, no one fertilizer plant is required to prepare the gross number of formulations reported for the State, but each important factory does have to prepare and ship more than is usual in other States. Labor is an important cost item in batching goods and it is obvious that management will have to study ways and means to reduce the size of this factor in order to remain competitive.

Davison's new plant at Fort Pierce, Florida, formerly NACO, was designed to reduce much of the complexity and labor of preparing a formulation by mechanizing the operation. This modern plant was designed and engineered by A. J. Sackett & Sons of Baltimore, Md. It does a push-button job of batching, printing the weight records of each of the raw materials of the batch, and automatically bagging the finished goods. This plant is able to turn out over 500 different formulations during the usual 10-month shipping season. Figure I illustrates how the automatic batching equipment works: one operator alone, by manipulating the controls, can handle up to 24 materials. It is so radically different in fertilizer technology as to seem fantastic to old-timers in this industry.

Other novel features in design are these: tractor shovels to move bulky materials; communication by means of colored light panels (Fig. 1) between the operators who select the bin and who operate the shovels. The operator who works the bin selector guides funnels placed above the conical hoppers. These funnels are called "bin selectors."

Above each hopper are dual bin selectors and they can guide two raw materials into any of the eight compartments of the hopper. If a large portion of the total mixture comprises one material, then it is possible to fill several compartments of the one bin with this material. The operator can withdraw that material as needed by means of one or more weigh valves. Thus, by mechanical agencies, much manual labor is reduced or eliminated and the amount of time otherwise consumed is substantially reduced, making it possible to put through considerably more in the same period of time.

In Fig. 1 you may see also the pneumatic controllers on the console

DAVISON'S NEW FT. PIERCE PLANT

fronting the operator. By turning these controllers the bulk-scale and mixer operator is able to weigh each component of the formulation. He can choose among three conical hoppers, each of which is divided into eight sections. The weigh valves, which are sliding doors operated by air pressure, placed at the bottom of each hopper compartment, control the flow of the materials, which can be full at the beginning of the batch and gradually be reduced to a mere dribble toward the end of making final adjustments. The flexibility is remarkable.

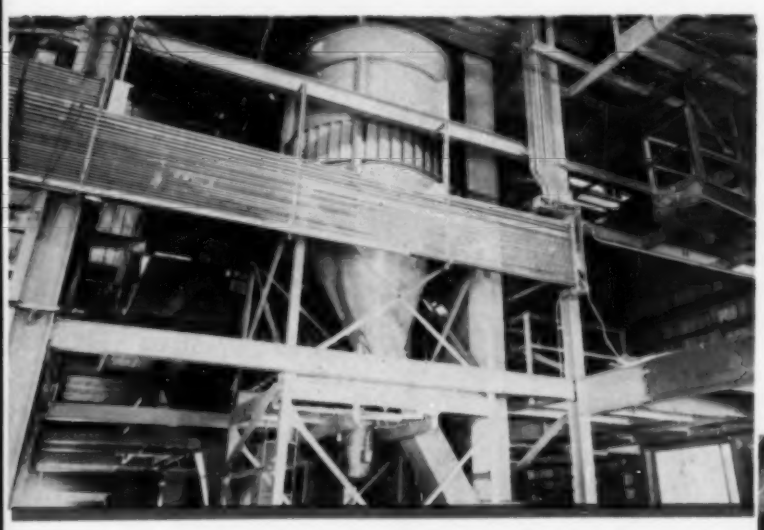
Another time saver is the use of automatic scales and printed tape records, which afford a permanent record of the amount of each component put into the batch. Consider that it takes less than five minutes for the weighing cycle involving a four ton batch and you can see that at this rate production could be maintained at about 50 tons per hour.

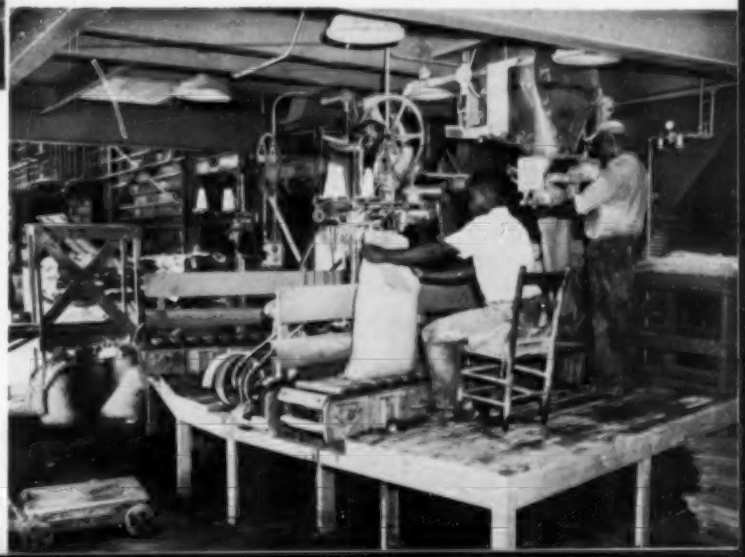
By Vincent Sauchelli
Davison Chemical Co., Division W. R. Grace & Co., Baltimore, Md.

Sackett installed a gravity mixer which can be manipulated by pushing another lever on the control console (Fig. 1). Material from this mixer is made to go to a vibrating screen, from which the classified product is fed to Richardson automatic bagging scales for final packaging. (Fig. 4).

A two-ton rotary mixer (Fig. 2) is available for making ammoniated bases by introducing either anhydrous ammonia or a nitrogen solution. As is well-known, heat is generated during ammoniation. To reduce the temperature in the mix the ammoniated base is dropped through a vertical flash cooler (Fig. 3) before it is conveyed to the curing bins, of which there are 28 in number.

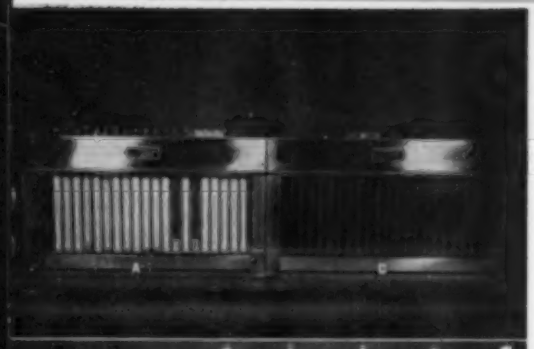
Storage and curing facilities are capable of holding 7,000 bulk tons. The building is designed to permit expansion of storage and bin capacity whenever future demands justify it.★★

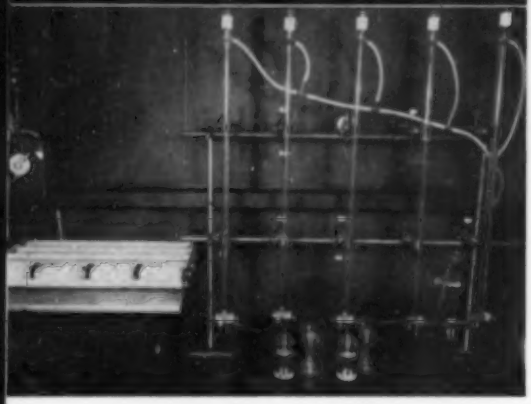




Top photo: (figure 3) Sackett vertical flash type cooler reduces temperature in the Davison mix before it is conveyed to the curing bins.

Bottom photo: (figure 4) The classified product is fed to Richardson automatic bagging scales for final packaging. Union Special sewing machines complete the operation.





Agricultural Emulsifiers

Top: Figure 1
Bottom: Figure 2

THE large scale application of an agricultural pesticide requires the distribution of a relatively small weight of a material of established activity per unit are of surface. Toxicants are rarely applied in pure form but usually are extended with solid or liquid diluents. About one half of the total applications are made from toxicant emulsions, which are formed by adding a solution of the toxicant and emulsifier in an organic solvent to water. The market available for surfactants for this use is approximately ten million pounds per year (1). There is every expectation that this market will continue to grow.

The important attributes of an emulsifiable concentrate (the toxicant, solvent, emulsifier solution) may be summarized under the headings of convenience, versatility, economy and stability. It must be convenient for the ultimate user to apply the formulation using a variety of equipment (very little of it remotely resembling a colloid mill), an individualistic method of handling, and diluent water of unknown and widely varying characteristics. Success must be achieved under a wide range of ambient temperture, whether the material is used unmodified or mixed with any one of a wide variety of other pesticides or additives. The formulator expects to be able to manufacture a line of perhaps one to two dozen pesticides without stocking more than a very few surface active agents. The entire formulation must be stable in the shipping container so that if this year's invasion of pests does not materialize, the supplies will be ready for next year's sales.

A large number of surfactants are employed in these formulations. In many cases, two or more surfactants are combined by either the supplier or user. Thus a discussion of the possible variation of the emulsifier would be prohibitive. The trend toward the utilization of mixed anionic-nonionic emulsifiers is worth noting, however. Specific combinations of these two types provide a high degree of self-emulsification, probably as the result of the low oil-water interfacial tension which may be achieved. The specific examples which are cited throughout this article are Triton X-150, Triton X-160 and Triton X-170, which are emulsifiers manufactured by the Rohm and Haas Company designed to handle a wide range of toxicants when blended in the proper ratios.

A testing program for agricultural emulsifiers must be designed to anticipate all of the vagaries of formulation and use. We shall describe in this paper the tests which we employ in the development of such products at the Rohm and Haas Company. As in any program of this type, we have borrowed freely from other technicians, and are constantly modifying our routine testing to reflect more accurately actual end use conditions. The criteria and the appropriate test methods are discussed individually.

Emulsion Stability

PROPER application of emulsions requires the maintenance of uniform distribution of toxicant in the water throughout the spraying operation. In general, emulsion stability requires:

a. Preservation of initial uniformity of distribution (lack of settling).

b. Lack of particle aggregation or coalescence.

c. Lack of separation of the oil phase.

Generally, little attention is given in the uses considered here to particle size per se, the only importance being its relationship to the rate of settling.

A number of methods may be devised for examining emulsion stability, but visual observation, using suitable containers and illumination, is usually adequate and economical.

For this purpose, we employ an Atlab shaker and viewer (2, 3). This

equipment is shown in Figures 1 and 2. A definite routine of pipet addition of toxicant to water is followed by 60 seconds of shaking. The emulsion is poured into the viewing tube, leveled to the top mark by a suction tube, and a timer started. Periodic observations of the entire tube length are recorded.

Observations which are made, usually over a two hour period, are of the following:

Creaming—settling of emulsion particles into a layer rich in oil particles.

Clearing—formation of an oil-poor layer characterized by comparative transparency.

Free Oil—breaking of the emulsion into an oil layer.

By G. L. Brown, G. C. Riley
Research Laboratories
Rohm & Haas Company
Philadelphia, Pa.

In recording the data, the following symbols are used:

T=top clearing
B=bottom creaming
t=top creaming
b=bottom clearing
FO=free oil
Capital letters used for oil phase heavier than water.
Lower case letters used for oil phase lighter than water.

The symbol is preceded by a number denoting the level (out of 100 divisions total) of the layer.

Thus the expression 120'—2B should imply that at the end of 120 minutes, 2% of the column is occupied by a cream layer which is heavier than water. In Figure 1, a number of stable emulsions are shown, along with two which have undergone extensive bottom creaming, and five in which free oil has separated.

It is obvious that a complete description of the stability of an emulsion of polydisperse particles cannot be given by one number. The above system, which uses a very compact notation, has been found to be very useful, without becoming too detailed.

We have considered and examined a number of other methods of determining emulsion stability, among them photo-extinction, gravimetric and hydrometer methods. Certain additional information may be gained, but it is by no means clear that they are advantageous in routine testing.

Versatility With Respect To Waters

THE range of water hardness which we have encountered spans a water of negative hardness (due to the presence of natural sequestrants) to one of 3200 ppm hardness (as $CaCO_3$). A convenient bench for emulsion make-up with several waters readily accessible as shown in Fig. 2.

It is difficult to obtain top performance over this entire range with one emulsifier. The performance of 6# Toxaphene formulation, incorporating Tritons X-160 or X-170, in waters of various hardness is shown in Figure 3. The bar graph denotes the range of water hardness over which the emulsion will give less than 5% creaming in two hours, and no free oil.

It will be noted that the scale of water hardness is constructed with negative values corresponding to sodium ion expressed as equivalent parts per million of calcium carbonate. The anionic—nonionic emulsifier systems respond to the addition of monovalent metal ions in the same manner as they do to a decrease in calcium ions. This "water softening" effect of sodium ions, for example, is not on an equivalent basis. That is, adding one mole of sodium ion is not equal to subtracting one mole of calcium ion.

Since a formulator cannot possibly control the types of waters with which his product will be emulsified, he must design the formulation to cover as broad a spectrum as possible. Fortunately, the distributor can often produce a formulation which will perform satisfactorily in a large area which is characterized by having a relatively narrow range of water hardness.

In testing an emulsifier in any toxicant-oil solution, behavior in a range of natural and synthetic waters is always determined.

Versatility in Toxicants

IT is well known by now that a specificity exists with respect to the surfactant which is most efficient in emulsifying a given toxicant—solvent combination. The short-hand notation H.L.B. for hydrophile-lipophile balance is widely accepted as a description of one aspect of the specificity (4).

In view of the necessity for designing a special emulsifier for nearly every toxicant solution, a single all-purpose emulsifier is difficult (perhaps impossible at present) to achieve. However, the use of mixtures of a small number of emulsifiers to achieve a range of HLB's is a practical compromise.

TABLE 1.
Water number compared with emulsification for various toxicants.

Toxicant—Solvent	Water No.	Specific Gravity	Ratio Triton X-150/X-160 For Best Performance in Distilled Water
4# Toxaphene-Kerosene	6.3±0.1	1.060	0
6# Toxaphene-Kerosene	7.1± .1	1.20	0
6# Chlordane-Kerosene	7.2± .1	1.180	0
8# Toxaphene-Kerosene	7.6± .2	1.335	1/5
25% DDT Aromatic Solvent	7.7± .1	1.025	0
8# Chlordane-Kerosene	8.2± .2	1.288	1/5
25% DDT - Aromatic solvent	8.2± .1	1.04	0
4# 2,4-D Butyl ester-Aromatic solvent	9.1± .1	1.08	1/5 to 1/2
4# 2,4-D Isopropyl ester-Aromatic solvent	9.3± .1	1.08	1/2
4# Toxaphene + 2# DDT-Xylene	9.3± .1	1.20	1/2
25% DDT-Xylene	9.4± .2	0.972	1/2
1.2# BHC + 2# DDT-Xylene	9.6± .0	1.068	1/1
0.8# BHC + 1.33# DDT-Xylene	9.9± .2	1.05	2/1
1# BHC - Xylene	10.0± .1	1.023	2/1
2# 2,4-D THF ester + 2# 2,4,5-T THF ester-Xylene	10.2± .1	1.14	1/1 to 2/1
4# Chloro-IPC-Xylene	10.9± .0	0.998	2/1

We have given a great deal of thought to the development of a measurement of HLB independent of emulsion trials, in order to reduce the multiplicity of experiments necessary in examining a range of mixtures for each toxicant. Preliminary work on a water number method indicated that the toxicant systems can be ordered by an independent measurement. Briefly, this measurement consists of a titration with water to a turbidity end point of a benzene-dioxane solution of the oil in question. The number assigned by this method and the ratio of emulsifier X found to give the best emulsion stability are compared in Table 1. It is seen that the overall correlation between water number and emulsifier ratio is good. This method was developed in our laboratory in cooperation with Dr. M. N. Fineman and Dr. H. L. Greenwald. A description of this method has been submitted for publication.

Occasionally an emulsifier is developed which is suitable for use in conjunction with only one specific toxicant. It is our feeling, however, that this is to be avoided, if possible, by the production of more versatile surfactants. The resistance of the user to the stocking of more than the minimum number of surfactants is very great.

Storage Stability of Emulsifiable Concentrates

THE labile nature of many pesticides, which are capable of releasing HCl upon standing, presents a serious problem in maintaining initial emulsification properties after prolonged storage. Toxaphene formulations are particularly troublesome, and we have therefore selected them for preliminary stability trials.

Stability tests are conducted by comparing emulsion stabilities before and after storage of samples in metal containers, simulating drum storage.

TABLE 2.

Temperature Stability—4% Emulsifier in 6# Toxaphene—Kerosene Storage at 60° C.

Storage Days	1000 PPM Water Triton X-160 SE 2 Hrs.	1000 PPM Water Experimental SE 2 Hrs.	Stoneville (Soft) Water Triton X-170 SE 2 Hrs.	Stoneville (Soft) Water Experimental SE 2 Hrs.
Zero	Ex. 1.5B	Ex. 1B	VG 2B	VG 5B
5	Ex. 1B	VG 2B	VG 2.5B	F 13B
10	Ex. 1B	VG 2B	VG 2B	F* 16B
15	Ex. 1B	VG' 10B	G-VG 3B	F 18B
20	Ex. 0.5B	VG 85T/15B	G-VG 2B	P 84T/16B
60	VG 2B	— —	G-VG 1.5B	— —

"SE"=Self Emulsification; "2 Hrs." = % creaming in the emulsion after 2 hours.
*Emulsion concentrate so dark that emulsions are discolored.

Ex. = Excellent VG = Very Good G = Good F = Fair P = Poor



Figure 4

A comparison of a 6# Toxaphene containing 4% Triton X-160 versus the same toxicant with a poorer experimental emulsifier is given in Table 2. The performance is compared during the course of aging in a natural soft water (Stoneville) and a synthetic hard water containing 1000 ppm $CaCO_3$. Appreciable stability differences are found between emulsifiers of the same general type, which emphasizes the importance of this test in each case. The addition of epichlorhydrin, often recommended as a stabilizer, has been found to be of little or no value in our tests.

It is quite possible for performance to show initial improvement up-

(*Turn to Page* 89)

Figure 3

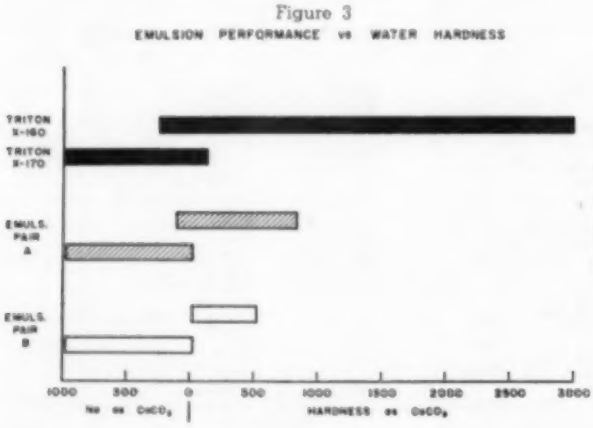
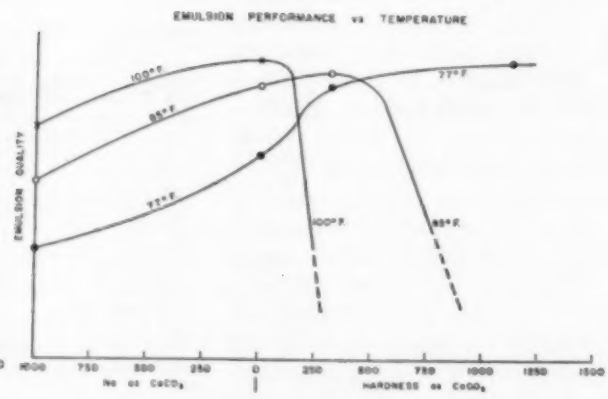
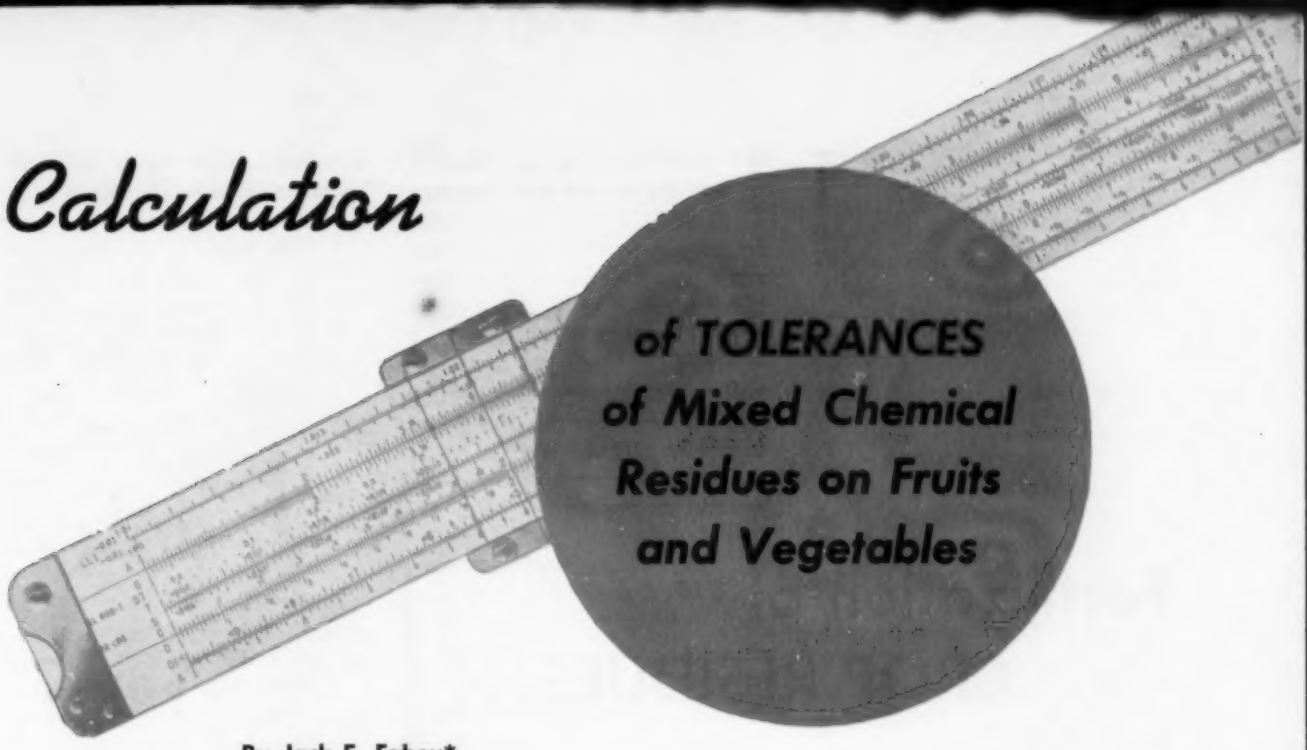


Figure 5



Calculation of TOLERANCES of Mixed Chemical Residues on Fruits and Vegetables



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IN the October 20, 1954 issue of the *Federal Register* tolerances for poisonous or deleterious residues on fruits and vegetables were proposed on the basis of data presented at the 1950 hearings held by the Food and Drug Administration. Subsequent issues (November 24, 1954, December 21, 1954, February 4, 1955, and March 11, 1955) contain additional information relative to the establishment and the administration of tolerances for pesticide chemicals in or on raw agricultural products. It is our purpose here to discuss the rules governing the occurrence of residues from two or more pesticides in a crop.

Because of the specificity of insecticides, fruits and vegetables may be sprayed with two or more chemicals for pest control during a season, with the result the pesticide residue may be a mixture of these chemicals. The proposed rules make the following declarations with respect to tolerances for mixtures of chemicals.

"Pesticide chemicals which cause related pharmacological effects will be regarded—as having an additive deleterious action.—Tolerances established for such related pesticide chemicals may limit the amount of a common component, such as As_2O_3, which may be present or may limit the amount of biological activity, such as cholinesterase inhibition which may be present, or may limit the total amount of related pesticide chemical, such as chlorinated hydrocarbons, which may be present."

The proposed rules further state, "Where two or more chemicals of the same class are present in a fruit or vegetable, the tolerance for the total such residues shall be the same as that for the chemicals having the lowest numerical tolerance in their class." Except that if "there are available methods that permit quantitative determination of each residue, the quantity of combined residues that are within the tolerance"—may be calculated on a percentage basis. Or if "there are available methods that permit quantitative determination of one or more, but not all, of the residues, the amounts of such residues as may be determinable shall be deducted from the total amount of residue present and the remainder shall have the same tolerance as that for the chemical having the lowest numerical tolerance in that class."

The foregoing quotations permit five interpretations for the calculation of tolerances of mixed residues.

1. If the ingredients are unrelated chemically and do not cause related pharmacological effects, then the tolerance for each ingredient must be considered separately. Thus, a residue of DDT and lead arsenate would have to meet the tolerances of 7 p.p.m. of DDT, 7 p.p.m. of lead and 3.5 p.p.m. of arsenic trioxide.

2. If the ingredients have a common component causing related pharmacological effects, then the residues are considered to be additive and the amount of the common component is limited. Thus, a residue of two or more arsenicals would have to meet a tolerance of 3.5 p.p.m. of arsenic trioxide or a residue of two or more metallic dithiocarbamates would have to meet a dithiocarbamate tolerance equivalent to 7 p.p.m. of zinc ethylene bisdithiocarbamate.

3. If the ingredients are in the same class (chlorinated hydrocarbons,

(*Continued on Page 85*)

*Presented at the North Central States Branch meeting of the Entomological Society of America, March 24-25, 1955, East Lansing, Michigan.

Fertilization of CROP RESIDUES . . . Does it Pay?

By W. V. Bartholomew
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IS there any practical value in applying nitrogen to crop residues in the field? Some say yes. Some say no. Most agricultural advisors admit they don't know. Since there is such a wide diversity of opinion on this important question, perhaps a review of the "pros" and "cons," as well as a critical examination of the applicable research data, would help to provide a reliable answer.

What influence, if any, can nitrogen have on crop residues? From the "pro" side of the question we frequently hear statements such as "you should apply some nitrogen to the corn stalks to hasten decomposition" or "you can't get full conversion of the straw to humus unless you supply adequate nitrogen." Other "pro" advocates have concluded that the addition of nitrogen fertilizer, by speeding up the decomposition of crop residues, will hasten the time when nitrogen will in turn be released in available form from the decomposing substances.

The "con" advocates contend that nitrogen has little or no influence on the course or rate of residue decomposition or on the nature and quantity of humic materials produced therefrom and, therefore, should not be added to residue materials in the field.

Which stand is most nearly correct, or do we have enough information to decide?

Let's first examine the "pro" claims. For convenience of discussion the reported major influences of nitrogen on the decomposition of crop residues may be listed in three parts as follows:

1. *The addition of fertilizer nitrogen hastens the rate of decomposition of low nitrogen residues such as corn stalks and cereal straw.*
2. *Nitrogen stabilizes carbon during the decomposition of plant residues or, in other words, the amount of soil organic matter formed from the decomposition of plant residues is in part related to amount of available nitrogen.*
3. *By fertilization of crop residues, nitrogen can be immobilized into the residues, stored and protected against loss and will become available to subsequent crops.*

Do research results show nitrogen to have these influences on residue decomposition? Let's examine first the influence of nitrogen on the rate of decomposition of plant residues.

The addition of nitrogen to low nitrogen residues like corn stalks and cereal straws has generally been found to speed up decomposition particularly during the first few weeks of decay (1, 2, 3, 5, 7, 14). On the other hand, after a year or more there is generally little difference in the extent of decomposition between nitrogen-treated and untreated residues.

A review of nine investigations which had been continued for a year or more (1, 4, 6, 14, 15, 18, 19, 22, 23) showed quite divergent influences of nitrogen (Fig. 1). In some cases nitrogen increased decomposition. In other cases nitrogen slowed the carbon loss. In all cases except in the work by Salter (22) the nitrogen-treated samples were not different from the no nitrogen checks by more than 15% — in most instances less than 10%. Moreover, these investigations included studies in which the rates had been as high as 100 pounds of nitrogen per ton of residue.

Although nitrogen has been shown to speed up the early stages

of decomposition — 1st month or 6 weeks — of non-leguminous residues, only a rather small quantity of nitrogen is required to obtain maximum speed of decay (Fig. 2). Increasingly more rapid rates of decomposition do not result from the addition of higher and higher amounts of nitrogen. Generally ten to twenty pounds of nitrogen per ton of residue results in a maximum rate of decay (11). Rates of nitrogen above these amounts generally have had no stimulating effect on decomposition, but, in some instances have actually slowed down the decomposition process (11, 20, 21).

Sufficient nitrogen to result in near maximum rates of residue decomposition under field conditions is usually made available from the soil during the decay process. If the soil were infertile, little nitrogen would be likely to become available, but correspondingly smaller yields of crop residue would be expected, which in turn would require less nitrogen for decomposition.

In the production of composts, or where abnormally large amounts of residue are applied to the soil, the addition of extra nitrogen to the extent of 10 to 15 pounds per ton of residue can be expected to hasten the early decomposition of the plant materials.

Does nitrogen stabilize carbon in the decay process?

Again the research data are not conclusive. Some experiments support the "pro" thesis. Some tend to disprove it. In ten decomposition studies which had been continued for more than one year, (1, 4, 6, 11, 14, 15, 18, 19, 22, 23), three found nitrogen to have had no measurable influence on the extent of decomposition, three found nitrogen to slow the rate of decay or to conserve carbon, and four found nitrogen to increase the rate of carbon loss. In general, the high rates of nitrogen addition have been most frequently associated with the slower rates of decomposition.

From the data at hand, it appears that under some conditions of decomposition and particularly if high rates of nitrogen addition are made, that slightly more organic matter may frequently result where nitrogen is applied to crop residues than where it is not added. The economy of the practice under normal field conditions, however, needs careful consideration. The organic carbon saved per unit of nitrogen applied is often very low (Fig. 3). (See Page 40).

In the experiments reviewed above, the greatest saving of carbon was 7 pounds per pound of nitrogen added, and the mean of all observations was about 1.6 pounds carbon saved per pound of nitrogen applied. When high amounts of nitrogen were applied, the saving was generally less than 2 pounds of carbon per pound of nitrogen added. This saving of carbon, even if it could be regularly obtained, is of questionable practical value.

Will low nitrogen residues like corn stalks and cereal straws tie up or immobilize extra available nitrogen during decomposition?

The answer is definitely yes — within limits. Only a limited number of microorganisms can grow on the food provided them by crop residues, and since nitrogen tie up must always start with the growth of microbial bodies there is a definite ceiling on immobilization of nitrogen in residues.

Many fresh residues contain around 15 pounds of nitrogen per ton. If conditions are favorable and additional nitrogen is available, the microbes will absorb another 10 or 20 pounds per ton during the early stages of decomposition (10, 17, 19, 20, 21). Providing the microbes with more nitrogen than they need results in little additional nitrogen uptake, and the extra nitrogen remains in the soil in inorganic form or may be lost by denitrification or by leaching if crops are not growing to absorb

Fig. 1. Influence of nitrogen on the extent of decomposition during incubations in excess of 1 year

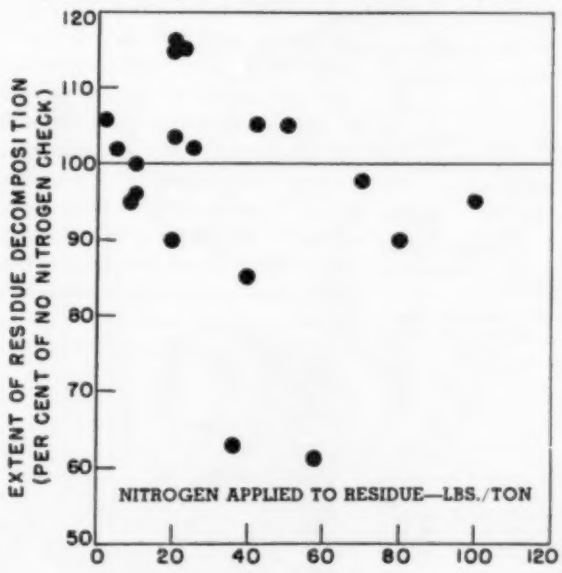
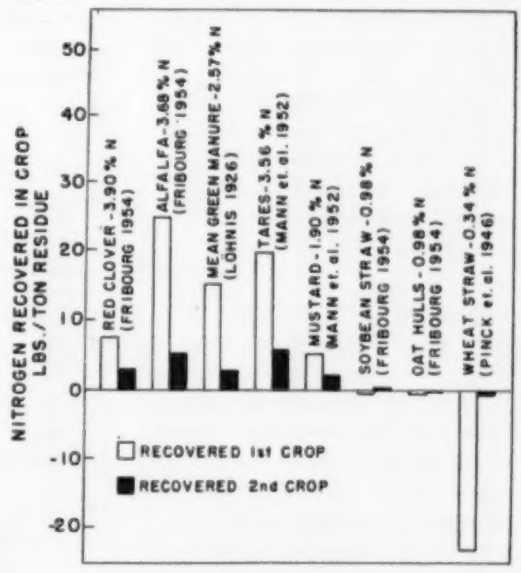


Fig. 2. Relation between available nitrogen and biological tie-up in decomposition of low nitrogen residues.



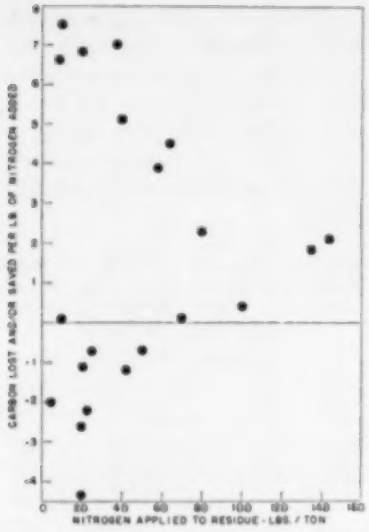


Fig. 3. The amount of carbon saved and/or lost by the addition of nitrogen to decomposing crop residues.

and to utilize it. The amount of total nitrogen needed to supply the microbial needs has been found to be between 24 and 34 lbs./ton of residue (1, 17, 18).

Nitrogen tied up or immobilized during the decomposition of crop residues is stored and protected from loss and will become available for crop growth at some later date. However, it should not be expected to make any important contribution to the crop the year following addition (3, 8, 9, 12, 13, 17) (Fig. 4).

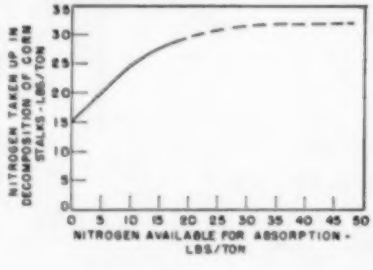
Nitrogen in leguminous residues is partly available during the season of application, and some measurable release in available form has often been noted in the year following the season of addition. The nitrogen tied up in low nitrogen crop residues like corn stalks and cereal straws, on the other hand, has not been found to make any measurable contribution to crop growth the year following addition. In many cases the yields on residue-treated plots have been equal to or lower than those on the untreated plots the year following application, indicating that the immobilized nitrogen continued to be tied up and was relatively unavailable.

Nitrogen immobilized in low nitrogen residues tends rapidly to become like soil organic nitrogen and is mineralized and made available each year at about the same rate as the humic nitrogen. Only a small fraction, estimated to vary between 1 and 3 per cent, of soil organic nitrogen becomes available each year. Nitrogen equivalent to even 5 per cent of that which is immobilized in ordinary corn crop residue would not be large enough to have a noticeable influence upon the crop that follows the corn. However, the long continued practice of adding residues, builds up a store of organic nitrogen which has an important influence on each crop that is grown.

The theory that in the decomposition process nitrogen saves carbon has an obscure origin. It seems to have grown out of some early observations that residues high in nitrogen, and low nitrogen residues to which nitrogen had been added, decompose more slowly than low nitrogen residues without extra nitrogen. The theory seems to have gained impetus from some general statements to the effect that soil organic matter can not be increased in the soil without the addition of nitrogen.

Also frequently cited in support of the theory are general field observations and results of some long continued fertility plots which have shown that where mineral nutrients and nitrogen have been applied the organic matter content of the soil was higher than where no fertilizers were applied. In the latter instances, however, due regard should be given to the larger amount of crop residues that inevitably result from fertilization.

Fig. 4. The availability of nitrogen in crop residues during the first and second season after application.



In conclusion then, should nitrogen fertilization of crop residues be generally advocated? In the light of the available information the practice is of questionable practical value except under special conditions. First, in normal farming operations the average soil will furnish sufficient nitrogen to obtain near maximum benefits from the low nitrogen crop residues. Second, extra additional nitrogen adds little to the value of the crop residue and any organic matter saved is expensive in terms of nitrogen applied. Third, a surplus of nitrogen will not be immobilized in the crop residue but remains in the soil generally in the nitrate form and if applied in advance of the season of crop growth may be subject to serious losses. Fourth, nitrogen immobilized in crop residues in the fall of the year will generally not be available to a crop the following season.

Nitrogen fertilizers are most advantageously used, not only for crop production but also for building soil organic matter, when properly applied to the crop to produce maximum economic yields. Highest yields of crops and the return of large quantities of residues have been shown conclusively to result in the highest levels of soil organic matter.

The farmer should apply the nitrogen fertilizer to his crop, and return to the soil high yields of residue. If he does this, the microbes can pretty well take care of themselves. The decomposition processes generally cannot be altered enough by the addition of nitrogen to make the effort worthwhile. It appears that only in the production of composts and artificial manures, or when large quantities of low nitrogen residues are returned to the soil, can the fertilization of residues be economically justified. Under ordinary farming operations it is of questionable practical value.★★

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A Visit to Battelle

By R. S. Davidson

Aerial view of Battelle Memorial Institute which provide ¾ million square feet of research laboratory facilities.

BATTELLE Institute, with headquarters in Columbus, Ohio, is a large, privately endowed institute conducting contract research for industrial companies, groups of companies, and branches of government. The sponsors of research at Battelle pay for the actual cost of the research and receive all results of the research, including patent and publication rights. Battelle does not engage in routine testing such as is done by commercial testing laboratories.

Research at Battelle is carried on in some forty-eight interlocking research and service divisions, which include practically all fields of technology except clinical medicine. One of these divisions, the subject of this article, is concerned with agricultural and biological research, under the direction of Dr. Richard S. Davidson.



Dr. R. S. Davidson (center), chief of the agricultural research division, discusses the cascade impactor with Dr. M. M. Baldwin (left), assistant technical director of chemical research, and Dr. J. M. Pilcher (right), assistant chief, division of applied physics. The cascade impactor, a recent development in the Institute's laboratories, has broad application in studies of the behavior of pesticide sprays and aerosols.

Development of Research at Battelle

WHEN Battelle Institute was founded, only twenty-six years ago, the chief emphasis was in the field of metallurgy. Anticipating a need for new markets for copper, three leading copper companies joined in asking Battelle to explore the possibilities for using more copper in agriculture. This led to research that unfolded a widespread need for copper additives to fertilizers and in livestock nutrition. Soon other types of agricultural problems began to come in: development of organic copper fungicides and of systemic selenium insecticides, the value of iodine as a plant nutrient, improvement of grain fumigants, controlling the safety of 2,4-D in lawn fertilizers, phytotoxicity of fluorine in smoke, etc., until

it became apparent that agricultural research had a real place in Battelle, and an agricultural division was formed.

At first, the major emphasis was on agricultural chemicals, and this remains a chief activity of the division, serving industry and agriculture in the development and control of new types of insecticides, agents for controlling fungus, bacterial, virus, nematode, and weed pests of plants, plant growth regulators, algaecides, fertilizers and soil conditioners, and pesticidal protectants for wood, fabrics, plastics, and other industrial materials.

The research services in the agricultural chemicals field broadened out to include other divisions at Battelle, until at present they extend to all phases: conception of new chemical structures with probable biological activity, synthesis of these, laboratory and greenhouse evaluation and advanced trials under field conditions, phytotoxicity, weathering, toxicology, studies of potential markets and of the economics of new agricultural chemical production and marketing, patent searches, formulating and packaging, chemical and physical properties and analytical methods for new agricultural chemicals, their production on pilot-plant scale, and full-scale plant engineering.

Meanwhile, industry began bringing other types of agricultural problems to Battelle, problems in formulation of livestock feeds, nutritional qualities of feeds and foods, seed technology, impregnation of seed with fertilizers, new uses for agricultural and forest residues and uses in agriculture for industrial wastes, and improved handling of farm produce, among others. This extended the agricultural research activities to other divisions of Battelle, until today there is hardly a division that has not been concerned with problems affecting agriculture, from metallurgy producing a better type of fence wire on to the use of X-rays for sterilizing veterinary supplies.

Most, but not all, of this research has been designed to solve practical problems of agriculture and of the industries serving agriculture or using its products. Some attention has also been given to more basic problems, as in the case of research using radioactive molecules to study the mechanism of how fungicides kill fungi, or studies on the structure of viruses that cause plant disease, using the ultracentrifuge, electron microscope, electrophoresis, and the other complex methods of modern physics.

From agriculture it was a natural and easy step to the other bio-sciences, and recently Battelle has been developing research in such related fields as food technology, chemurgy, forest products, animal physiology, aquatic biology, pharmaceuticals, non-clinical aspects of medicine, and industrial microbiology. Application of the techniques of modern biophysics and biochemistry to problems in these fields has been especially productive.

Staff, Facilities, and Methods

AT Battelle in Columbus is a staff of some 2200 persons, two thirds of whom have college degrees in science. Virtually all fields of science and technology are represented, including men professionally trained in agricultural chemistry, agronomy, horticulture, entomology, plant pathology, veterinary biology, bacteriology, and the other branches of the biosciences, intimately associated with specialists in the physical sciences and industrial and agricultural economics. Here on a 50-acre tract are more than 3/4 million square feet of laboratory floor space, where are provided all the standard tools for industrial research, ranging from apparatus used in microanalysis to two-story chemical engineering pilot plants. Nearby is a horticultural field plot and orchard area with greenhouses and accessory biological laboratories, while not far outside the city is a 400-acre farm for both industrial and agricultural research.

In Florida, Battelle maintains a sub-station for atmospheric, marine, and biological deterioration studies. The biosciences are also well represented in the new Battelle laboratories in Frankfurt, Germany, and Geneva, Switzerland, which are served by offices in the major West European capitals.

No attempt is made to maintain a network of experimental farms. Instead, when a research development reaches the stage requiring extensive field testing under practical conditions, use is made of cooperative relationships with many state agricultural experiment stations, other research organizations, and private farmers. The solution of a problem is sometimes found in seemingly unrelated studies. A seed technologist, for example, who was trying to make a difficult separation of two similar types of seeds, succeeded with a technique used in a Battelle ore beneficiation laboratory, where, although the materials are very different, the basic problem is the same—separating similar particles of matter. Some of the developments in fuels research have been found to have applications in agricultural spraying and dusting. Work on injection of fuels into combustion chambers for example, has led to development of a cascade impactor for determining the drop-size distribution of fine sprays and aerosols and this, in turn, has use in connection with improved atomization of sprays and nozzle design.

The Role of Private Institutes

IN the United States, government spends $140 million per year for agricultural research. One might ask: What further need is there for privately supported agricultural research? There are several situations in which private research finds its field of usefulness:

When the results would benefit one company in competition with others, it would be improper to aid the one company by research at public expense. When the problem is very urgent, private laboratories can sometimes achieve a higher tempo, get results more quickly than is usual in governmental ones or in institutions where effort is divided between research and education. When a problem requires industrial confidence, it may be impossible to maintain the necessary security in a public insti-

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Recent Developments on the

BROWN COTTON LEAFWORM

THE brown cotton leafworm, *Acantia dacia*, a new pest of cotton in Texas caused severe damage to thousands of acres of cotton in 1954. This insect was collected in Texas cotton fields during 1953, but no serious damage was reported at that time. The following summation on the control of this pest, extent of damage, etc., is a report by D. F. Martin* and W. J. Mistric, Jr.** published as "Progress Report 1704" by the Texas Agricultural Experiment Station, Texas A & M College System, College Station, Texas:

The brown cotton leafworm was found to cause considerable "ragging" of cotton in certain fields of south-central, eastern and upper coastal areas of Texas, especially in Brazos, Burleson, Robertson, Wharton and Matagorda counties. Noticeable damage to the foliage began to appear during the first week in July 1954. By mid-July severe damage by the worms extended over several thousand acres of cotton. Collections of this insect were made in 1953 by C. R. Parencia, Entomology Research Branch, U. S. Department of Agriculture; on July 6, 7 and 8 in Austin, Robertson and Wharton counties, although no damage was reported at that time.

The damage appears first as small "buck shot" holes in the cotton leaves, which become larger as the larvae continue to feed. Plants may be completely defoliated if heavy infestations occur.

Description Of Larva And Adult

THE larva, which crawls with a looping motion, has three pairs of abdominal prolegs and is reddish-brown in color. When full grown, it measures approximately 1¾ inches in length. One black spot is located on each side of the body just behind the third pair of thoracic legs, and an irregular pale yellowish-white line extends from each spot along the sides of the body almost to the hind end of the larva.

Results of preliminary laboratory tests are shown in Table 1. Effective control was obtained with parathion, malathion and endrin. Toxaphene, DDT, cryolite, gamma BHC and calcium arsenate were ineffective at the dosages used.

The moth or miller is about half an inch long with a wingspread of approximately 1 inch. The upper surface of the wings of the female is yellowish-gray; the fore wings are dark brownish on the apical two-thirds or more. The upper surface of the wings of the male is pale gray with the tips of the fore wings blackish.

Population build-ups and damage occurred in fields being treated regularly with most of the chlorinated hydrocarbons recommended for control of various insects attacking cotton.

Results of a field test are shown in Table 2. Materials were applied by airplane. Initial infestation counts were made immediately before the

(*Continued on Page 88*)

TABLE 1.

Results of laboratory cage toxicity tests for the control of a brown cotton leafworm using insecticides as indicated, College Station, 1954.

Treatment	Dose[1] Spray	Dose[1] Dust	Percent control[2]
Toxaphene	2.00		62
	3.00		53
Parathion	0.25		100
	0.125		100
Endrin	0.25		81
	0.33		90
DDT	1.00		18
	1.50		31
Malathion	0.25		100
	0.50		100
Gamma BHC	0.30		13
	0.40		40
Cryolite		10	46
		15	47
Calcium arsenate		10	23
		15	41

[1]Pounds active ingredients per acre.
[2]Abbotts Formula used to calculate precentage control.

TABLE 2.

Results of a field test for control of a brown cotton leafworm using insecticides as indicated, College Station, 1954

Material	Dose[1] Spray	Dose[1] Dust	Percent reduction
Parathion	0.25		100
	0.50		100
Endrin	0.33		97
Gamma BHC	0.40		77
5-10-40[2]		10	0

[1]Pounds active ingredients per acre.
[2]5 percent gamma BHC-10 percent DDT-40 percent sulfur.

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Synthetic SOIL CONDITIONERS

. . . effect on crop yield

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SOME of the recently developed synthetic soil conditioners (8) give research workers an important new tool for stabilizing soil aggregates in certain fine-textured clays. Although such conditioners are now too costly for extensive field use, they could prove practical for growing house plants, for starting plants, and for treating the soil of rows or hills (9) in which plants are to grow in the garden.

Structure and texture are important because they control movement of air and water in the soil. Texture is determined by size and proportion of the soil particles. Structure refers to the arrangement of the soil particles. In productive soils, the aggregates of particles may vary in size from crumbs barely visible, to those plainly visible. Desirable aggregation of the type described is promoted largely by organic matter (2, 7). Synthetic polyelectrolytes properly applied (4) appear to affect soil structure as much as organic matter does. Highly significant positive correlations between the degree of soil aggregation caused by polyelectrolytes and yields of some vegetables have been reported (1, 3, 4).

Material And Methods

Soil and Soil Treatment

FIELD experiments were conducted on Beltsville silt loam, a fine-textured "problem" soil, at Beltsville, Maryland in 1953. This soil becomes hard and compact following rains. The effects of three synthetic stabilizers on soil aggregates and yields of some vegetables were determined. The calcium salt of vinyl acetate and maleic acid (VAMA), the sodium salt of hydrolyzed polyacrylonitriles (HPAN), and carboxymethylcellulose (CMC) were used.

A green cover of winter rye was plowed under and disced into the soil with 1,000 pounds per acre of 5-10-5 fertilizer in the early spring of 1953. VAMA and HPAN were each used at the rates of 500 and 2,000 pounds per acre. CMC was used at the rate of 2,500 pounds per acre. The conditioners were broadcast on the surface of the soil with a hand fertilizer distributor and thoroughly mixed with the soil with a rotary tiller. The moisture content of the soil at the time of mixing did not exceed 10 per cent. The soil was worked again with the rotary tiller just before each vegetable was planted.

The treatments were randomized in 4 replicates. Single plots were 10 by 16 feet.

Crops Grown

The vegetable plants grown as indicators of treatment effects were Early Chatham tomato, Salad Bowl lettuce, Imperida carrots and Fordhook 242 bush lima beans.

Carrot and lettuce seeds were sown by a seed drill on April 29. Seedlings were thinned successively until the carrot plants were 3 to 4 inches apart and the lettuce plants about 12 inches. Lettuce yields were recorded on July 8 and carrot yields on August 26, when the majority of plants were at the prime marketable stage.

Tomato plants were started in good composted soil in the greenhouse and transplanted to the field on May 13, 1953, when they were

TABLE 1.
Effect of synethic soil conditioners on fruit yield per plant of Early Chatham tomato variety.

Soil Conditioner		Early fruit		Midseason fruit		Late fruit		Total fruit	
Name	Rate per acre	Weight	Increase over check	Weight	Increase over check	Weight	Increase over check	Weight	Increase over check
	Pounds	Pounds	Percent	Pounds	Percent	Pounds	Percent	Pounds	Percent
None (check)	.....	.3	.....	1.4	.....	1.1	.....	2.8	.....
VAMA	500	.5	67	2.9	107	2.9	164	6.3	125
VAMA	2,000	.7	133	3.1	121	4.0	263	7.8	178
HPAN	500	.4	33	1.7	21	1.1	0	3.2	14
HPAN	2,500	.6	100	4.4	214	3.1	182	8.1	189
CMC	2,500	.3	0	1.3	.....	1.0	0	2.6	0
L. S. D. at .05		.2		.9		1.7		1.4	
L. S. D. at .01		.3		1.2		2.3		1.9	

TABLE 2.

Effect of synthetic soil conditioners on fresh weights of tops and roots per plant of Early Chatham tomato variety

Soil conditioner		Tops		Roots	
Name	Rate per acre	Weight	Increase over check	Weight	Increase over check
	Pounds	Grams	Percent	Grams	Percent
None (check)	.....	314	.....	22	.....
VAMA	500	526	68	40	82
VAMA	2,000	577	84	45	105
HPAN	500	364	16	26	18
HPAN	2,000	543	73	44	100
CMC	2,500	319	2	25	14
L. S. D. at .05		118		15	
L. S. D. at .01		162		18	

–Taken just after the last harvest of fruit.

TABLE 3.

Effect of synthetic soil conditioners on fresh weights of single tops and roots of Salad Bowl lettuce plants.

Soil conditioner		Tops		Roots	
Name	Rate per acre	Weight	Increase over check	Weight	Increase over check
	Pounds	Grams	Percent	Grams	Percent
None (check)	.....	129	.....	8.5	.....
VAMA	500	252	96	17.0	100
VAMA	2,000	336	161	25.5	200
HPAN	500	218	70	11.3	33
HPAN	2,000	230	78	14.2	67
CMC	2,500	129	0	8.5	0
L. S. D. at .05		64		5.1	
L. S. D. at .01		90		6.8	

5 weeks old. Eight plants were grown in each plot. They were fertilized, irrigated, and treated with pesticides as required. This kept the plants in a vigorously growing and healthy condition throughout the season. Yields of mature green and red fruits were recorded weekly from July 8 to August 10.

Lima beans were planted 2 inches apart and 3 inches deep on June 8. Successive thinning was done until the plants were approximately 12 inches apart. Yield records were taken on September 4, when the majority of the pods were green mature.

Results And Discussion

Effect of Conditioners on the Soil

VAMA and HPAN conditioners appeared to stabilize the soil aggregates in Beltsville silt loam for the entire growing season. These conditioners caused no puddling and permitted water to penetrate the soil rapidly. After each rain or watering the surface of conditioned soil always dried out more rapidly than that of nonconditioned soil. The latter remained wet and sticky longer and became more compact and difficult to cultivate. At the end of the season, stabilized agggregates were still noticeable in plots treated with VAMA and HPAN while the aggregates had disappeared from the nonconditioned soil. Removal of roots of the vegetable plants from conditioned soil was also considerably easier than from nonconditioned soil. Other workers (3, 4, 5) have reported similar results in "problem" fine-textured soils.

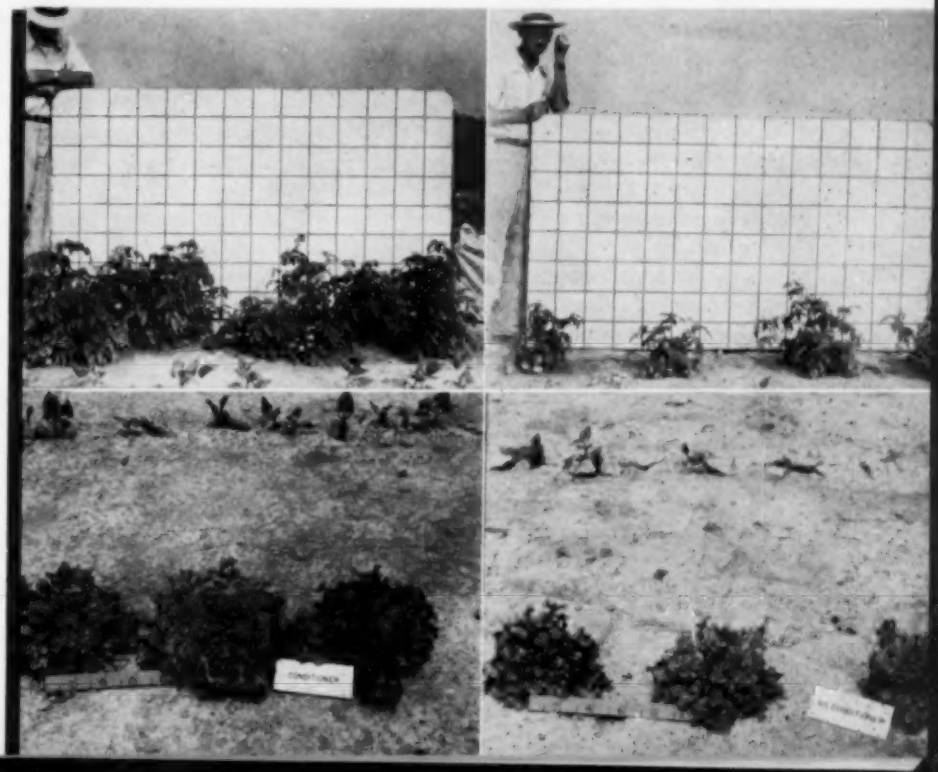
CMC at the rate of 2,500 pounds per acre was equal to VAMA at 500 pounds per acre, as judged by the stability of soil aggregates 0.25mm in diameter in the upper 3 inches of the soil. However, vegetable yields on the plots treated with CMC were essentially the same as those on nonconditioned plots. This situation apparently requires further study, but it may be explained by the fact that approximately the surface inch of soil in the CMC plots was in a badly

Fig. 1—Upper left: Early Chatham tomato plants in plots treated with VAMA conditioner grew faster, became larger and significantly outyielded plants in soil that received no conditioner, shown in Figure 2.

Fig. 2—Upper right: Early Chatham tomato plants in plots that received no conditioner grew slower, were smaller and were significantly outyielded by plants that grew in conditioned soil.

Fig. 3—Lower Left: Salad Bowl lettuce in plots treated with VAMA grew faster and were significantly larger than plants in plots that received no conditioner, as shown in Figure 4. In background, note lima bean seedlings, which emerged easily and rapidly.

Fig. 4—Lower right: Salad Bowl lettuce plants in plots that received no conditioner grew slower and were significantly smaller when harvested than plants grown in plots treated with VAMA or HPAN. In background, lima bean seedlings had difficulty in breaking through hard soil crust.



puddled or cemented condition. The soil below the surface in the CMC treated plots appeared considerably more friable than the sub-surface of nonconditioned plots.

Effect of Conditioners on Vegetable Crops

TOMATO. The effect of the tested synthetic soil conditioners on plant size is shown in Figures 1 and 2. The average fruit yield per plant and fresh weights of tops and roots of Early Chatham tomato variety are given in Tables 1 and 2, respectively. Significantly higher yields of mid-season, late, and total fruit were obtained with VAMA at 500 pounds per acre rate than with HPAN. At 2,000 pounds per acre, both materials significantly increased total yields and yields at each harvest period as compared with those on untreated plots. There was no significant superiority of one conditioner over the other at the 2000-pound rate as indicated by early, late or total harvest of fruit. These results agree with those of Martin (5) and of Martin et al (6), who reported that tomatoes and corn grown on soil treated with VAMA or HPAN matured earlier and produced substantial increases in total yields. Alderfer (1) also reported significant yield increases for tomatoes, peppers, sweet corn, lima beans, and carrots. CMC at the rate of 2,500 pounds per acre had no effect on fruit yield and fresh weight of plant tops.



Fig. 5 — VAMA conditioner improved the shape and increased the weight of marketable Imperida carrots.

VAMA and HPAN at the 2000-pound rate caused significant increases in fresh weight of plant tops and in root weight of tomato over the control.

LETTUCE. VAMA and HPAN at rates of 500 and 2,000 pounds per acre caused significant increases in fresh weight of lettuce tops (Table 3 and Figures 3 and 4). VAMA was significantly superior to HPAN at both rates of application in increasing fresh weight of roots, and at 2,000 pounds it was superior in increasing weight of tops. CMC had no effect on lettuce yields.

CARROTS. When VAMA and HPAN were used at the rate of 500 pounds per acre the increase in marketable roots and their weights were not significant, but when the rate was 2000 pounds per acre the increases were significant (Table 4 and Figure 5). CMC had no effect on carrot yields.

LIMA BEANS. VAMA and HPAN caused significant increases in yield of usable pods per lima bean plant and in fresh weight of plants when used at the rate of 2,000 pounds per acre. Although 500 pounds per acre of these synthetic soil conditioners caused a small increase in yield, it was not significant. CMC had no effect on bean yields.

Summary

1. VAMA and HPAN stabilized granules in a Beltsville silt loam soil for the entire growing season. These treatments enhanced the infiltration of water and improved the growth of the vegetable plants tested.
2. CMC, at 2,500 pounds per acre, improved the stability of soil aggregates at a depth of 1 to 3 inches but did not affect crop yields significantly. The surface inch of soil treated with CMC became badly puddled.

(*Continued on Page 99*)

TABLE 4.

Effect of synthetic soil conditioners on percent of marketable roots and fresh weight of single roots with tops of Imperida carrots.

Soil conditioner			Weight of single root with top	
Name	Rate per acre	Roots marketable	Actual amount	Increase over check
	Pounds	Percent	Ounces	Percent
None (check)	.....	41	2.71	.....
VAMA	500	59	3.21	18
VAMA	2,000	85	3.90	43
HPAN	500	63	3.00	11
HPAN	2,000	67	3.46	28
CMC	2,500	40	2.39	.....
L. S. D. at .05		25	.54	
L. S. D. at .01		35	.71	

TABLE 5.

Effect of synthetic soil conditioners on yield of usable pods and fresh weight per plant of Fordhook 242 bush lima beans.

Soil conditioner		Usable Pods		Fresh weight of entire plant*	
Name	Rate per acre	Weight	Increase over check	Weight	Increase over check
	Pounds	Grams	Percent	Grams	Percent
None (check)	.....	140	.....	316	.....
VAMA	500	160	11	379	20
VAMA	2,000	213	52	504	59
HPAN	500	165	18	375	19
HPAN	2,000	209	49	450	42
CMC	2,500	151	8	335	.....
L. S. D. at .05		53		87	
L. S. D. at .01		74		121	

*Immediately after usable pods were harvested.

CHEMICALS for AGRICULTURE

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DURING the ten-year period from 1945 to 1954, consumption of all plant food materials approximately doubled, as contrasted with a growth rate for all industrial chemicals of only 67%. Dollar sales of fertilizers during this same ten-year interval increased by a factor of about 2.6, while those for the "Chemicals and Allied Products" category about doubled. Nitrogen has shown the most rapid increase of the three plant food materials, with a growth factor of 2.8 during the decade, compared with 2.4 for potash and 1.5 for phosphate.

Use of economic poisons has shown an even more dramatic growth during this interval, having increased in tonnage by a factor of about 2.7 and in dollar value by a factor of approximately 3.

In the fertilizer field, one of the main criteria which has been applied in judging prospective growth has been cash farm income. The close relationship between fertilizer expenditures and cash farm income for the previous year was well-established up until about 1948, when expenditures for fertilizer began to exceed those which might have been anticipated from farm income. This was due to a number of causes, including the adoption of fertilization practices in some of the newer farming territories of the country, and to some extent, the increasing use of nonfarm fertilizers on gardens and lawns.

Starting from a base of $32 billion in 1945, cash farm income increased to a peak of about $33 billion in 1951 and has since declined slightly to the level of about $30 billion. Expenditures for fertilizers, meanwhile, starting from a base of $440 million have shown a steady upward progression to the present level of $1.14 billion. Thus, the percent of farmer's income being spent for fertilizer materials has nearly doubled during this ten-year period. Nevertheless, the rate of increase of this percentage within the past couple of years has declined substantially from that previously experienced; farm prosperity is therefore still an important factor, even though its impact may have diminished somewhat. Long-term prospects for agriculture are, of course, favored by population growth, which places heavier demands on a relatively limited supply of farmland.

There are a number of basic reasons for projecting continued growth in fertilizer usage even though farm prosperity is unchanged. As one measure, only about 25% of the total crop land in the country receives any application of fertilizer materials. Furthermore, the usage in many areas remains considerably under that which would represent either optimum economic performance or the usage which has already been realized in some areas of the country. For example, the expenditure for fertilizers in most of the Eastern states averages between 8¢ and 15¢ per dollar of cash farm income; as one moves westward, the figure is reduced to about 3¢ in Wisconsin and Minnesota, and to a fraction of a cent in the Dakotas. Soil conditions are admittedly different in these areas, but these figures portray the substantial difference between the older and newer farming areas.

The extent to which plant food materials are being removed from the soil by crops furnishes another guide to prospective fertilizer usage, although it probably has little value in any short-term projection. Calculations show that the amount of nitrogen being taken from the soil by cropping is about 290% of replacement; the figure for phosphate is 82%, and for potash 170%. These figures do not, of course, take into account any losses due to erosion, leaching, and other factors, or any gains due to soil decomposition and bacterial fixation.

One of the best demonstrations of the benefits from use of more fertilizer materials is the added return to the farmer in crop value for each dollar he invests in fertilizer. This value varies for different sections of the country and for different crops, but calculations have shown it to be $3 to $5 for crops such as corn, cotton, and wheat. Admittedly these figures do not take into account the cost of handling or application, which are difficult to calculate quantitatively. Nevertheless, this sales argument is the one which probably has been used most effectively by the fertilizer distributors as well as the governmental and state groups concerned with fertilizers utilization. Such an approach applies not only in times of heavy food demand, when the main emphasis is on increasing crop output, but also at times of over-production of crops, when farmers must minimize expenses in order to achieve a profitable operation.

Virtually all state experiment stations offer recommendations to farmers for application of fertilizer materials to various crops grown in that state. These recommendations have, in many cases, increased in recent years, and are generally based upon the levels which have been found to represent efficient farm management in those areas, even though they may not be the absolute point of optimum performance. If one calculates

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the total plant food needs of the country on the basis of these recommendations, however, it is apparent that the fertilizer industry would have to at least double in order to meet current requirements. This fact does not necessarily mean that the impact of the promotional work being done by such agencies is nil, but rather that the trend towards acceptance of the concept of fertilization is slow, and that considerable educational work is still needed.

Some time ago, we undertook a comprehensive survey of state agronomic groups, in order to obtain estimates of the most likely levels of fertilizer usage if the farm prosperity level remained constant. This survey showed that the state agronomists expected annual increases in the foreseeable future of about 150,000 tons of nitrogen, 200,000 tons of phosphate, and 150,000 tons of potash. Actually, in the light of later evidence, it is probable that the projections of phosphate growth should be reduced somewhat, since recent experience has shown a declining ratio of P_2O_5; a better estimate may be an increase of about 125-150,000 tons per year.

Some of the changes occurring in the mixed goods industry may also be of interest. The general trend towards more complex processing of fertilizer materials may change the general character of this industry from one of materials handling and distribution to a relatively more complicated operation. Such factors as increased use of nitrogen solutions, manufacture of ammonium sulfate in the mixture by over-acidulation and subsequent neutralization with ammonia, granulation, and the requirements for high-analysis mixtures, nitric phosphates, ammonium phosphates, triple superphosphate, and the like—all will influence the extent to which the mixer and compounder is required to add additional processing equipment, and to increase his investment per unit of sales.

These practices may also lead to increased participation by the basic materials manufacturer in the fabrication of complete fertilizer materials. This trend is already evident in the moves by some of the producers of ammonia to manufacture balanced fertilizers such as the nitric phosphates and ammonium phosphates, and in the integration by many of the fertilizer companies to produce high-analysis phosphates such as triple superphosphate. While no revolution in fertilizer manufacturing and marketing practices is anticipated, participation by the basic materials manufacturers in the fertilizer business is expected to continue to increase.

Another general trend which is expected to continue relates to the concentration of materials used as fertilizers. There has been a general upward movement in the concentration of plant food in fertilizer materials during the past several years, with the average now reaching about 25% of combined N, P_2O_5, and K_2O. With higher rates now applicable for freight, handling, bagging, and other services, there is increased economic incentive to raise the plant food content; furthermore, the greater availability of triple superphosphate for use as a base material in high-analysis mixtures favors a higher average concentration. Thus, the recent upward movement in concentration of about 1% per year may reasonably be expected to continue.

The trend towards higher nitrogen and potash content in the average plant-food ratio has already been indicated, although projections based on historical experience may be dangerous here. About five years ago, the average plant food ratio for all materials used in the United States was about 1:2:1, but this has since declined to about 1:1.2:1, indicating the relatively lesser importance of phosphate. On the other hand, there is now increasing recognition that nitrogen and potash may become relatively overbalanced, so that the rate of change in ratio may be slowed. While there is nothing magical about the ratio of 1:1:1, this seems to be still a fair estimate of the probable leveling-out point which might be realized over the next five years.

Increased use of separate materials as against mixed fertilizers has an important influence on the position of the individual fabricators of ingredients and mixtures. One of the main reasons is that farmers are increasingly employing separate materials, especially nitrogen materials, as side dressing during the growing season, in addition to the balanced fertilizer used at planting time. Thus, there has been no absolute reduction in the quantity of mixtures used, but rather relatively faster growth in the practices as application of anhydrous separate materials. Advent of such ammonia has also favored the increased use of individual products, because of the economies which can be achieved. There will undoubtedly be further change in the percentage of materials sold as individual products; nevertheless, there will again tend to be a leveling out as soils demonstrate greater need for phosphate and potash, and as the industry becomes better set up to distribute mixed fertilizer materials to the farmer, at reduced cost, by such techniques as bulk spreading, or through local formulating stations which can combine high-analysis base goods shipped to that point.

Of the individual materials employed in fertilizers, the nitrogen field is, of course, dominated by synthetic ammonia. Ammonia now accounts for about 66% of the total nitrogen requirement for agriculture, and its proportion is increasing as imported materials and by-product ammonium sulfate assume lesser importance. Moves to increase ammonia capacity in recent years have been well-publicized; there are now 35 plants producing synthetic ammonia in the United States. Some of these are still being expanded, and some 20 additional plants are in various stages of planning or construction. Capacity has grown from about 1.1 million tons of nitrogen in 1945 to 2.8 million tons at present. Further increases are projected to 3.0 million tons by the end of this year, and 3.8 million tons by the end of 1956.

Ammonia capacity is therefore increasing faster than the rate of growth of nitrogen consumption in

(*Continued on Page 85*)

Fertilizer Urea and its Properties

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CONSUMPTION of urea as fertilizer in the United States increased from 73 short tons imported in 1925 to approximately 47,000 tons domestically produced in 1948. Production by direct synthesis began in the early thirties. In 1932 the du Pont Company began making urea ammoniating solutions and followed with the introduction of crystal urea in 1935. By 1948, with only one domestic plant in production, the total U. S. supply of domestic and imported urea for all industrial purposes, including plastics, feed for ruminants, fertilizers, medicines, fermentation processes, seasoning of lumber, adhesives manufacture, textile finishing and printing, fireproofing processes, and organic synthesis, was more than 116,000 tons. At present urea is produced at five plants in the U. S. and construction has been started on another. The rated capacities of the three newest plants and the one under construction are estimated to total more than 600 tons of urea per day. Increasing supplies of urea have stimulated an already rising interest in its use as a source of nitrogen for processing mixed fertilizers as well as for direct application to the soil.

The accumulation of knowledge concerning urea had its beginning as long ago as the 18th century when Scheele and other chemists noted the presence of "a particular nitrogeneous substance" in urine. Rouelle, in 1773, showed that this substance was rich in nitrogen. Fourcroy and Vauquellin, in 1798-99, discovered that this material, which they called urea, formed crystals of ureanitrate when strong nitric acid was added to concentrated urine, but they did not isolate the urea. Prout, in 1820, obtained pure urea from the urea nitrate. He established the definite composition of the compound in 1824. Subsequently is was learned that normal human urine contains about 22 grams of urea per liter and that urea occurs naturally as the principal nitrogeneous constituent in the urine of all carnivorous and omnivorous mammals. Small quantities of urea have been found in other animal secretions, in the leaves of spinach and carrots, and in the seedlings of various plants. However, none of the materials, in which urea occurs naturally, are economical sources for large-scale commercial production of the compound.

The first synthetic preparation of urea was accomplished by Wohler in 1828 during attempts to combine ammonia and cyanic acid. Various methods of synthesizing urea followed. In 1868 Basarov proposed the direct conversion of ammonium carbamate into urea and in 1882 W. G. Mixter obtained urea by passing carbon dioxide and ammonia through a tube heated to low redness. In 1913 the success of the Haber process for the synthesis of ammonia was assured. During World War I the process was developed by the Germans and this provided both the ammonia and carbon dioxide necessary for the direct and economical production of urea. Present production processes are based on the chemical combination of ammonia with carbon dioxide to form ammonium carbamate which is then decomposed to yield urea and water.

Properties

UREA is the amide of carbonic acid and is sometimes called carbamide. Pure urea normally crystallizes in long, colorless to white needles but its crystal size and structure may be modified by various manufacturing techniques. Its formula is $CO(NH_2)_2$, nitrogen content 46.65% (fertilizer grade 45%), molecular weight 60.06, melting point 132.7° C. (269.6° F.), absolute specific gravity 1.335 at 20° C., and its apparent density (loosely packed) is about 42 pounds per cubic foot as compared with about 55 pounds per cubic foot for mixed fertilizer.

Solubility

Urea and ammonium nitrate are the two most soluble solid materials used as fertilizer. The approximate solubility of urea at different temperatures as compared with that of ammonium nitrate and ammonium sulfate is given in Table I. The high solubilities of urea and ammonium

nitrate contribute to large increases in volume of solution as compared with the volume of water in which the respective salt is dissolved. Table II indicates the approximate volumes of solution obtained by dissolving different amounts of urea in a given volume of water as compared with similar data for ammonium nitrate. The indicated volumes of solution were calculated from the approximate specific volumes of urea and ammonium nitrate determined at 50°C. and at concentrations of 120 and 200 grams of material, respectively, per 100 grams of water.

The solubilities of urea and ammonium nitrate are mutually enhanced in the presence of each other. The approximate volumes of solution formed by dissolving mixtures of these two salts in varying proportions in 100 grams of water at 30°C. (86°F.) are given in Table III. The table shows that 1564 grams of a mixture containing 46% urea and 54% ammonium nitrate will dissolve in 100 grams of water to yield a solution containing 719 grams of urea and 845 grams of ammonium nitrate and having a volume approximately 12 times that of the original 100 grams of water.

Hygroscopicity

Urea is moderately hygroscopic. The hygroscopicity, or tendency of a substance to absorb moisture from the surrounding air, is indicated by the relative humidity of the air in equilibrium with its saturated solution. The hygroscopicities of urea and its admixtures with other common fertilizer salts at 30°C. (86°F.) are given in Table IV. With the exceptions of calcium nitrate, ammonium nitrate and sodium nitrate, urea is more hygroscopic at this temperature than any of the other salts listed. Also its mixtures with other fertilizer salts are more hygroscopic than urea alone and its mixture with ammonium nitrate forms an extremely hygroscopic product. As indicated in the first footnote of Table IV, these observations hold only when the solution is saturated with respect to both salts.

Reactions

When heated above 133° C. (271° F.) in the absence of water, urea loses ammonia and forms biuret, $NH(CONH_2)_2$. When heated with water or with dilute acids or alkalis, it begins to decompose at temperatures as low as 50° C. (122° F.) to yield ammonia and carbon dioxide.

Urea forms complexes with several inorganic fertilizer compounds. Typical examples of complexes formed by the combination of urea with inorganic salts are

$Ca(NO_3)_2 \cdot 4CO(NH_2)_2$
$NH_4Cl \cdot CO(NH_2)_2$
$CaSO_4 \cdot 4CO(NH_2)_2$
$MgSO_4 \cdot 4CO(NH_2)_2 \cdot 3H_2O$
$MgSO_4 \cdot 5CO(NH_2)_2 \cdot 2H_2O$
$MgSO_4 \cdot 6CO(NH_2)_2 \cdot 2H_2O$
$Mg(NO_3)_2 \cdot 4CO(NH_2)_2 \cdot 2H_2O$

Monocalcium phosphate monohydrate and urea react to form urea

(*Turn to Page 91*)

TABLE I.

Comparative Water-Solubilities of Urea, Ammonium Nitrate, and Ammonium Sulfate

Temperature		Approximate Solubility in 100 grams Water		
		Urea	Ammonium Nitrate	Ammonium Sulfate
°C.	°F.	grams	grams	
10	50	84	158	73
20	68	105	195	76
30	86	133	242	78
40	104	166	297	81
50	122	205	344	85
60	140	246	421	87
70	158	315	499	91
80	176	410	580	94
90	194	542	740	98
100	212	745	871	102

TABLE II.

Effect of Dissolved Solid on the Volume of Solution

Material per 100 grams Water	Approximate Volume of Solution per 100 grams of Water	
	Urea[1]	Ammonium Nitrate[1]
grams	ml.	ml.
200	258	234
300	336	299
400	414	365

[1]Technical-grade materials were used.

TABLE III.

Relative Volumes of Aqueous Solutions Saturated with Urea and Ammonium Nitrate in Varying Proportions at at 30° C. (86° F.)

Component	Proportion of Dissolved Salt										
Urea	0	10	20	30	40	46	50	60	70	80	100
Ammonium Nitrate	100	90	80	70	60	54	50	40	30	20	0
	Grams per 100 grams water										
$CO(NH_2)_2$	0	29	74	164	375	719	482	266	204	172	133
NH_4NO_3	242	259	294	381	562	845	482	178	87	43	0
Total salt	242	288	368	545	937	1564	964	444	291	215	133
	Ml. per 100 grams water										
Solution volume	251	290	348	472	757	1206	786	420	313	260	201

TABLE IV.

Hygroscopicity of Common Fertilizer Salts and Their Admixtures with Urea at 30° C. (86° F.)

Fertilizer Salt		Relative Humidity of the Air in Equilibrium with a Saturated Solution of the Salt	
Name	Formula	Alone	In Admixture with Urea[1]
Urea	$CO(NH_2)_2$	72.5	—
Ammonium nitrate	NH_4NO_3	59.4	18.1
Sodium nitrate	$NANO_3$	72.4	45.6
Calcium nitrate	$Ca(NO_3)_2 \cdot 4H_2O$	46.7	66.7[2]
Sodium chloride	NaCl	75.2	52.8
Ammonium sulfate	$(NH_4)_2SO_4$	79.2	56.4
Ammonium chloride	NH_4CL	77.2	57.9
Monocalcium phosphate	$Ca(H_2PO_4)_2 \cdot H_2O$	93.7	65.1
Ammonium phosphate	$NH_4H_2PO_4$	91.6	65.2
Potassium phosphate	KH_2PO_4	92.9	70.1
Potassium sulfate	K_2SO_4	96.3	71.5
Potassium nitrate	KNO_3	90.5	65.2
Potassium chloride	KCl	84.0	60.3

[1]The solid phase of each salt was present except as noted.
[2]The solid phase was $Ca(NO_3)_2 \cdot 4CO(NH_2)_2$.



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Does FLY CONTROL on Livestock PAY?

THE values derived from the use of fly sprays on livestock have been under consideration since colonial times with varying comments and results. In the period 1915-1925 several repellent sprays were used, but they afforded only limited protection and for only a short time. The use of pyrethrin sprays, DDT and "rhothane" in more recent years have given considerably more satisfactory results. The annoyance, irritation and loss of blood caused by flies results in a reduction of milk flow in dairy cows and loss of flesh in other animals. The actual values derived from the use of fly sprays on livestock however, were uncertain. Some reports over various periods indicated a gain in milk production, others showed that the use of some of the sprays available was accompanied by a decline in milk production. It seems highly probable that many interrelated factors may have contributed to the confusion, e.g., species involved, variations in fly population densities, time and frequency of observations, dosage rates, efficiency of the sprays used and variations in the nature and degree of adverse effects some materials had upon the animals treated.

The findings of Shaw and Atkeson (1943) came as quite a shock to industry, when they reported that the use of fly sprays did not increase milk production. J. J. Davis, (1938) however, had already provided the clue that many workers overlooked. Observing a herd sprayed daily from June 21 to September 9, 1926, and a comparable check herd, Davis found: "During the first few weeks of the tests and before flies were abundant, the sprayed animals showed a decrease in milk production. In other words spraying seemed to have a definite adverse effect on the animals. However, as the animals became accustomed to the spray and as the flies became increasingly abundant, the treated animals returned to their normal or near normal milk production, while the unprotected animals showed a gradual but distinct decline in milk production.

"The net result was that the check or unsprayed lot showed a total net rate of decline of 32 per cent for the entire time of the experiment, while the average total net rate of decline for all sprayed lots combined was only 13.4 per cent or a difference of 18.6 per cent in favor of the sprayed cows.

The findings of W. N. Bruce and G. C. Decker (1947) seem to be in complete agreement with the work presented by Davis. Furthermore, in studying 12 farm herds they found that: "The production level of all herds seems to be directly related to management, and in general the low-producing herds showed the largest gain from fly control. These data support the contention of dairy experts that the greatest apparent increase in milk production will occur in poorly managed herds where flies interfere with grazing."

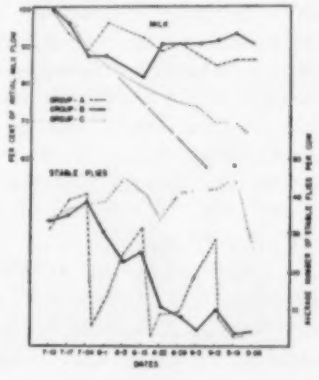
Considering the above comments and evidence, it would appear that perhaps the use of high-producing animals and the alternation or rotation of treatments at frequent intervals may have played important roles in predetermining the results by A. O. Shaw (1943) and others.

The work of F. W. Atkeson (1931), D. C. Howell and F. A. Fenton (1944), and others would seem to indicate that the stock sprays available in the early 1940's, though much improved over earlier products, were not entirely devoid of harmful properties and were only partially effective in repelling flies, many showing considerable weakness within a few hours after treatment.

The appearance of DDT and more recently the synergized pyrethrin sprays introduced a new era in fly control. Through their use we have acquired new and more encouraging data.

(*Continued on Page* 83)

Figure 1. Average per cent of the initial milk production per cow and average number of horn flies per cow for: (A) herds sprayed with residual deposits of Rhothane or DDT, (B) herds sprayed daily with small quantities of DDT, and (C) herds sprayed with conventional repellent type sprays.



*Based on a paper by George C. Decker at the Chemical Specialties Manufacturers' Association, May 16-17, Chicago, Illinois.

WASHINGTON *Report*

by
Donald G. Lerch
Cornwell, Inc., Washington, D. C.
(Agricultural Chemicals Washington Correspondent)

COMMISSIONER George P. Larrick, Food & Drug Administration, is facing a deluge of problems as the Miller Amendment enters its first full month of operation following the effective date of July 22nd. Commissioner Larrick aims at handling extensions and exemptions so as to minimize the inevitable confusion. Generally speaking, he appears to have succeeded rather well.

Addressing himself to the general problem, Mr. Larrick feels that "the chemical industry is giving our chemists and pharmacologists such a backlog of work that we cannot keep up. The emergence of new chemicals demanding entry into the food supply is running far ahead of the scientific knowledge needed to be sure of their safety." Here the Commissioner is thinking about both additives as well as pesticide residues.

Commenting specifically on the Miller Amendment, Mr. Larrick feels that its significance can hardly be over-estimated. "It adopts a new approach to this overwhelming problem," he feels. "In effect it puts the great scientific resources of industry to work with us on this all-important question of safety. It makes the manufacturer of the pesticide responsible for establishing that his product is useful and that it can be used in safe amounts."

Further demonstrating its willingness to cooperate fully with the Miller Amendment, The National Agricultural Chemicals Association, has just established a "Miller Law Liaison Committee." Members are: J. A. Noone, Chairman, Technical Advisor, NACA; W. W. Sunderland, Vice Chairman, The Dow Chemical Company; Leo R. Gardner, vice president & manager, research & development, California Spray - Chemical Corporation; and L. Gordon Utter, manager, technical service, research & development department, Diamond Alkali Company.

The purpose of the Committee is to serve as a liaison group between the agricultural chemical industry and the two federal agencies directly involved in the administration and enforcement of this law, the Food & Drug Administration and the Department of Agriculture. It is intended that the committee will meet periodically with representatives of these agencies. At such conferences, it will present for consideration and discussion matters and problems of broad interest to the industry as they develop. It is anticipated that the Government representatives will also present similar matters and problems as they encounter them.

Recognizing its own limitations, the Committee will seek mainly to determine issues for study by other specialized groups rather than to resolve them.

Lea S. Hitchner, executive secretary of N.A.C.A. believes that the committee, through cooperation with the Federal agencies, can and will make important contributions to the development of proper standards and procedures for the implementation of the Miller Pesticide Amendment and thereby serve the best interests of agriculture, the public, government and industry.

Commission Larrick has put a $500 price tag on Miller Law activity. Certain exemptions are provided in accordance with the regulations as published in the *Federal Register*. Final cost can be more or less, depending on the amount of work involved.

* * *

In commenting on AC's discussion of the new problems that face in secticide research workers this season in the light of passage of the Miller Bill (July issue, pages 53 and 54) a highly placed official in the Entomology Research Branch of the U.S.D.A. makes an important distinction between two distinctly separate steps in the field evaluation of new pesticides. In the first stage of field evaluation, immediately following laboratory testing, a new pesticide is customarily applied to a variety of crops on a small scale. Subsequently compounds which have shown exceptional promise in pre liminary field testing must be evaluated on a larger scale under a variety of conditions.

Even prior to the passage of the Miller bill, this authority points out, those concerned with such test programs normally arranged, at least in the initial, small-scale field test programs, to purchase or condemn treated crops if there was any likelihood of toxic residues remaining on the harvested crop. He agrees, however, that in the follow-up large-scale field test programs, where substantial quantities of harvested crops are involved, it is seldom feasible to purchase or condemn large quantities of treated crops.

He indicated that from conversations with officials of the Food and Drug Administration he had gained the impression they would rely to a great extent on the federal and state experiment stations to use good judgment in the use of new pesticides in the stage of small scale field experiments. He expressed the hope that in the later large-scale tests, where substantial quantities of produce are in-

volved, special consideration may be given and it may be possible to have reasonable experimental tolerances established with a minimum of red tape. Large scale tests, he points out, are vital in the development of new pesticides. Unless some means is found to allow them to continue, research in this field will be seriously impeded, he believes.

* * *

"Jim Howell is doing a top-flight job!" That's what you hear in Washington as Mr. Howell takes up his new duties as president of the National Plant Food Institute. You can bet that there'll be a lot of trips between Washington and his home in Richmond, where he is president of the Virginia-Carolina Chemical Corporation. Mr. Howell has been one of the architects of the consolidation and is recognized throughout the industry for his forceful leadership.

After a short delay the new Plant Food Institute staff, totalling 23 in all, is to be housed in new quarters on the 10th floor of the Commerce Building, at 1700 K Street, Washington, D. C.—right next door to the old address of the American Plant Food Council.

Executive vice president Paul T. Truitt will handle Government affairs, including state and Federal relations—a post for which he is well qualified, based on his previous Washington accomplishments both in and out of the fertilizer industry. It can be expected that this phase of the new Institute program will be handled with vigor and thoroughness.

Executive vice president Dr. Russell Coleman has the primary responsibility for directing the Institute's research and educational programs, and is directly concerned with the general staff operation. Dr. Coleman's extensive experience in the agronomic field and the wide-spread respect he has earned over the years are being put to excellent use in his new capacity.

Vice president W. R. Allstetter is responsible for the banker program, which has won attention throughout the country, as well as other executive functions.

Louis H. Wilson, the Institute's secretary, is in charge of general public relations, including liaison with the media groups as well as the creation of public relations and publicity programs.

Dr. Malcolm McVickar heads agronomic education, including the production of motion pictures, and is secretary of the research and technical committee.

Dr. W. H. Garman is in charge of the agronomic relations function of the Institute, including scholarships as well as the many other aspects of this scientific field.

Delbert Rucker edits the new *Plant Food Review*, and heads the important publications phase of the Institute's operation.

Feeling among some of the 23-member staff is that they have the new program well organized, and that following the inevitable period of readjustment the new Institute will shortly be ready to provide the full measure of service to the fertilizer industry previously developed by the two separate organizations.

General yardstick for operation of the new Institute is—"if it's good for the farmer, it's good for the fertilizer industry that serves the farmer."

* * *

The importance of research will be the theme of the forthcoming annual convention of the National Agricultural Chemicals Association, scheduled for Spring Lake, New Jersey, September 7-9. Speakers will present points of view on behalf of industry and Government. The general problem as it applies to the pesticide industry is simply to maintain continuous development of a sufficient number of products to enable farmers to produce wholesome, marketable food with enough data to assure safety both for the farmer and the general public.

Since many of the problems in this field become largely a matter of degree, scientific evidence is only one phase. The other is interpretation of the results and education.

In answer to requests and because of the great interest, another panel on the Miller Amendment will be held at the convention, featuring officials from the Food & Drug Administration, the U. S. Department of Agriculture, Cornell University and NACA.

As usual, a record turn-out is expected for the convention. Members of the Association are urged to take advantage of the hotel reservation procedure established by NAC.

* * *

New Government programs are being developed to provide closer business relationships between businessmen in North and South America. One such program, still in the embryonic stage, is to encourage a bigger and better flow of agricultural information through Latin American media to farmers. It is felt that as more and more farmers hear and read more about new practical developments in agriculture, they will be able to improve the efficiency of their products and increase their incomes.

The pesticide industry in particular would seem to have a very definite interest in this objective for improvement in the flow of farm information to South American farmers. It would certainly tend to increase the market for pesticides. The same might be true to some extent for fertilizers or at least certain fertilizer materials.

It appears likely that certain aspects of the program will be such a nature that NAC and other associations may cooperate. There will also be some direct contacts made to agricultural writers and broadcasters and U. S. companies operating in South America. *Agricultural Chemicals* will keep you posted on developments.★★

* * *

Int'l Minerals Names Carney

Gerard J. Carney was recently appointed marketing staff manager of the Plant Food Division of International Minerals & Chemical Corp., Chicago.

Mr. Carney was formerly vice president and general sales manager of the Dayton Pump and Manufacturing Co., Dayton, Ohio. His business career has also included sales management responsibilities for farm and garden equipment with Lodge & Shipley Co., Cincinnati.

LISTENING *Post*

Downy Mildew Control on Cucurbits; Antibiotics for Celery Blight

This department, which reviews current plant disease and insect control problems, is a regular monthly feature of AGRICULTURAL CHEMICALS. The comments on current plant disease problems are based on observations submitted by collaborators of the Plant Disease Epidemics and Identification Section, Horticultural Crops Research Branch, U. S. Department of Agriculture, Beltsville, Md.



By Paul R. Miller

F. S. Beecher of the Horticultural Crops Branch, Agricultural Research Service, says that preferences for fungicidal sprays to control downy mildew (*Pseudoperonospora cubensis*) of cucurbit crops have varied in different areas, fixed coppers, zineb, and ziram being the chemicals used most generally. In trials at Beltsville, Maryland in 1952, when other diseases were not present to confuse the picture, zineb (Dithane Z-78) gave good control of downy mildew on cucumbers and was superior to Tri-basic copper sulfate. However, Tri-basic copper sulfate very effectively controlled the bacterial disease angular leaf spot (*Pseudomonas lachrymans*) of cucumber, whereas Dithane Z-78 was ineffective. Therefore tests were begun in 1953 to determine what a combination of Tri-basic copper sulfate with a dithiocarbamate might do in controlling both downy mildew and angular leaf spot on cucumbers and downy mildew on muskmelons.

It was thought formerly that tank mixtures of a fixed copper with a dithiocarbamate would produce foliage injury, but tests for two years at Beltsville have shown no such injury attributable to the combined spray materials. Plots of 48 plants each, replicated four times, were used. In this location the early summer is usually warm to hot with high humidity, becoming hotter and usually drier as the season advances. Possibly where the weather is cool and rainy the results might be somewhat different.

In the 1953 tests a tank mixture of Tri-basic copper sulfate with Dithane Z-78 (3:2:100) gave the best mildew control on cucumbers, while on muskmelons a Tri-basic copper sulfate-ziram (Zerlate) mixture (3:2:100) appeared somewhat better. This apparent difference may have been due to the slow progress of mildew and the appearance of considerable infection by the leaf blight fungus (*Alternaria cucumerina*) on the melon foliage, where it may have been controlled better by the Tri-basic copper sulfate-Zerlate mixture. Even for control of angular leaf spot on cucumbers, the Tri-basic copper sulfate-Dithane Z-78 mixture was a close second to the Tri-basic copper sulfate alone. As the mixtures of the fixed copper and dithiocarbamates caused no foliage injury, it seemed desirable to continue the tests, especially as these mixtures seemed to give better downy mildew control than any of the ingredients alone.

In 1954, tank mixtures of Tri-basic copper sulfate with zineb or ziram, as well as alternate sprays of the same materials, were tried again. Field tests on both cucumbers and muskmelons showed that a tank mixture (3:2:100) of Tri-basic copper sulfate with Dithane Z-78 gave better control of downy mildew than any other materials tested. This mixture proved even better than a spray of Tri-basic copper sulfate (4:100) alternated with Dithane Z-78 (2:100).

All sprays were applied at 7-day intervals at pressures of about 200 pounds. A spreader ("Tween 20") and an insecticide ("Tubacide," a rotenone extract) were added to all sprays. No foliage injury due to the spray materials was seen at any time.

These limited tests included only combinations of Tri-basic copper sulfate with various dithiocarbamates, and further testing will be necessary to determine what results might be obtained with other strengths of these materials, or with combinations of other fixed coppers with dithiocarbamates. Up to now, however, the Tri-basic copper sulfate-Dithane Z-78 mixture at 3:2:100 has given the best control of cucurbit downy mildew. Thus far it appears that certain mixtures of Tri-basic copper sulfate with a dithiocarbamate possess some fungicidal value not inherent in the single ingredients when used alone.

Control Of Bacterial Blight Of Celery

R. S. Cox, of the University of Florida Everglades Experiment Station, writes that bacterial blight ((*Pseudomonas apii*) is one of the most serious celery seedbed diseases in the Everglades, even though little attention has been given to it. This may have been due to several factors. The disease is seldom important in field plantings, although if adequate control is not obtained in the seedbed, subsequent plantings in the field may suffer; it has been troublesome only on the early plantings (July to September); and copper fungicides recommended for the control of this disease were used exclusively in the celery seedbed until recent years.

In the Everglades, most celery growers believe that copper alone does not provide adequate control of seedbed diseases other than bacterial blight. Since copper is not considered to be compatible with the organic fungicides used against these other diseases, a separate spray operation

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becomes necessary. As a result of this dual program, the interval between applications of copper is lengthened to at least once a week until bacterial blight appears. When this occurs, the growers attempt to spray twice weekly with copper, while at the same time continuing the alternate schedule with the organics. Since the disease is most destructive during the rainy period in the fall, field conditions frequently become such that it is not always possible to maintain this dual program. This is aggravated further by the size of operations, which makes schedules difficult to follow because of equipment shortage. It appeared desirable, therefore, to develop a more efficient spray program. One obvious approach would be through the testing of the antibiotic, streptomycin, separately and in mixture with copper against bacterial blight. This is a preliminary report on results obtained in 1954. The commercial formulation used is sold under the trade name Agrimycin and was supplied by Charles Pfizer, Co., Brooklyn. It contains streptomycin and terramycin in a 10-1 ratio.

Sprays were applied with a commercial rig that delivered 200 pounds pressure. The test was done on standard 4 x 300-foot beds and each plot consisted of three beds. The materials were applied at the rate of approximately 8 gallons to each bed. A total of five applications were made weekly intervals, except for the second which was applied after 3 days. The treatments were randomized and replicated.

At the time of the first application the disease was uniformly distributed throughout the plots. Because of the rather high incidence, the Agrimycin plots received heavy applications the first two times.

Results are shown in Table 1. Both Agrimycin and Copper A gave a high degree of control; also, Agrimycin appeared to be more effective than copper. Where a straight copper schedule was used (Schedule D) the disease gradually built up, whereas with Agrimycin the opposite was the case.

(Continued on Page 88)

TABLE 1.
Effect of various materials on bacterial blight severity, Belle Glade, Florida, 1954.

Treatment	Concentration	Disease severity[c] Sept. 14	Sept. 28
A. Check		2.75	8.25
B. Streptomycin-Terramycin (Agrimycin-100)	300 - 300 - 100 - 100 - 100 - ppm[b]	1.75	8.25
C. Streptomycin-Terramycin Agrimycin-100)	600 - 600 - 200 - 200 - 200 - ppm[d]	1.00	0.50
D. Copper A (45% C-O-C-S)	4 lbs/100 gal.	1.25	2.25
E. Streptomycin-Terramycin plus Copper A	Schedules B plus D	0.50	0.25
LSD .05			1.97

[a]Materials applied on following dates: September 4, 7, 14, 21, 28. In another test the following materials used alone were ineffective: zineb, captan, dichlone, chloranil, ferbam, zirbam, and Lo 738.
[b]Parts per million of streptomycin in 100 gallons.
[c]Disease severity scored on a 0 to 11 basis.

Boll Weevil Spotty; Corn Borer a Problem; Fruit Pests Light



This column, reviewing current insect control programs, is a regular feature of AGRICULTURAL CHEMICALS. Mr. Dorward is head—Economic Insect Survey Section, Plant Pest Control Branch, U. S. Department of Agriculture. His observations are based on latest reports from collaborators in the U.S.D.A.'s pest surveys throughout the U. S.

By Kelvin Dorward

IN New Jersey, during the latter part of June, the Colorado potato beetle was worse on untreated potatoes and tomatoes than it was in 1954. This insect was also a problem on these crops in Delaware and was damaging tomatoes in Rockland County, New York. Damage to potatoes was also reported from northern Illinois as well as Yakima, Washington. More reports on abundance and destructiveness of the beetle were being received in Indiana than usual, and Virginia was expecting damage to potatoes unless treatments were applied. Infestation was general but less than last year in the Red River Valley of North Dakota. It is reported that DDT has not been effective in controlling this insect in this area again this year.

The adult pea weevil population was very heavy in the northern area of Idaho during late June, but there was very little vine growth of peas due to dry weather, and it was possible that most of the weevils would die before depositing eggs. However, control operations were under way on the pest in the southern part of the state. Populations were higher than usual in Utah.

In early July the striped cucumber beetle was heavy in home gardens in the Newport and Wickford, Rhode Island, areas. Populations up to 30 beetles per cucumber leaf were recorded. Lighter populations were common over the entire state. Moderately heavy damage was recorded to cucumbers west of Dover, Delaware, and to watermelons at Canterbury, Delaware. Squash plants were severely damaged by the beetle in Allegany County, Maryland, and populations were quite heavy on vine crops in Westchester County, New York. Damage was reported to cucurbits in the Wahpeton area of North Dakota and moderate populations were occurring on melon plantings in the central area of Oklahoma.

Aphids of various species were active in areas throughout the country. Potato aphids were increasing on tomatoes in Rockland County, New

York, on potatoes in Saratoga County and on both crops in Wayne County. This aphid was heavy on tomatoes in eastern Nebraska Counties and causing injury to that crop in the Kansas City, Missouri, section. Treatment was necessary for tomatoes in the northern area of Illinois. Canning peas required control for the pea aphid in the Cache Valley of Utah, and in central and south Minnesota where populations were heavier than in the past several years. Canners in Minnesota report more than normal respraying necessary to control the insect.

The green peach aphid which caused economic damage to tobacco for the first time in 1947 is reported heavy on that crop in several areas. In the Clarksville area of Tennessee, infestations are the most severe since 1950. In that area, dark fire-cured tobacco was more heavily infested than burley. In many fields of Florence County, South Carolina, populations were unusually high and some heavy infestations were reported from Pittsylvania County, Virginia. In North Carolina, however, predators were instrumental in markedly reducing populations of the aphid.

Boll Weevil Activity Spotty

BOLL weevil activity in Texas during late June and early July was ahead of the period last year. Hibernation cage tests at Waco, Texas, to June 24, showed a weevil survival of 10.9 as compared to 2.9 on the same date in 1954. By early July there was a slight increase in boll weevil population in the upper-coastal and south-central Texas areas but for the time of year, populations were extremely heavy in the central, north central, west cross timbers, east and northeast areas. In the lower Rio Grande Valley, losses in some fields where controls were begun late or improperly applied, exceeded 50 per cent. Up to July 1 infestations were fairly light in Oklahoma. To that time, the heaviest infestation was 24 per cent punctured squares in one Choctaw County field. Since that date infestations have been on the increase. Early populations were relatively light in Arkansas, but by the early part of June some insecticides were needed. In the Tallulah, Louisiana, area all 91 fields examined were infested, with punctured squares averaging 9 per cent. Other Louisiana Parishes reporting punctured square averages were Red River, two fields, 12 per cent; Bossier, three fields, 41 per cent; Ouachita, five fields, 21 per cent and Tensas, five fields, 14 per cent. Counts in Tennessee during early July were low. The same was true in Mississippi, but activity appeared to be increasing. In southeastern Alabama of 43 fields examined 38 were found infested with an average of 5.4 per cent. Untreated fields examined in middle and south Georgia showed an average of 11 per cent punctured squares, with all fields examined infested. At Florence, South Carolina, cage survival to July 1 was above the 24 year average, being 5.8 percent compared to 3.6. Total weevils taken in a trap plot to June 30 was 1521 compared with 76 to the same date in 1954. Of 177 fields surveyed in North Carolina, 45 were found to be free from boll weevils, approximately 85 had less than 10 percent infestation and the remainder 10 percent or more.

Activity of other cotton insects has been relatively light to date.

Alfalfa Weevil Found in North Dakota

THE alfalfa weevil which previously had been reported from the adjacent states of South Dakota and Montana and the Province of Saskatchewan, Canada, has now been found in North Dakota. In a survey made during the week of June 20, specimens were collected in Adams, Bowman, Slope and Stark Counties. All infestations found were in trace amounts.

European Corn Borer Problem

THE European corn borer problem continues to cause concern in some states. Controls were well under way in Illinois, and in Iowa there was much more general use of recommended control practices than in preceding years. Southwestern Kentucky counties appeared to have the heaviest European corn borer infestation since 1950-51. The insect was more abundant in the Clarksville, Tennessee, area than for several years.

Fruit Insect Activity Light

FRUIT insect activity during this period has been relatively light, with mites perhaps causing the most concern. In many Ohio orchards the European red mite was very severe. Control was necessary in the Carbondale, Illinois, area. Mite population increases were noted in Pennsylvania, West Virginia, Missouri, Utah and Arizona.★★

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Ant Control on Citrus

Granular formulations of dieldrin, heptachlor, chlordane, and aldrin spread evenly over the ground in citrus orchards have given as good ant control as comparative spray tests, in California orchards.

In preliminary studies, the insecticides were formulated at 2½ to 5 percent actual toxicant, on granules of bentonites, attapulgus clays, vermiculite, and on screened cut tobacco stems. The revolving disc spreader is recommended for applying the granules. Argentine Ant Control on Citrus, G. E. Carman, *California Agriculture*, May, 1955.

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Scale, Aphid Control

Methods are now available which make much easier the control of scale insects and aphids on ornamental plants. Research conducted by John C. Schread, entomologist at the Connecticut Agricultural Experiment Station, using new insecticides for control of these pests, has yielded very satisfactory results. Mr. Schread has summarized his findings in a new Station bulletin, which is available to homeowners, nurserymen, florists, and others interested.

Pests discussed in the bulletin include the hawthorn aphid, the viburnum aphid, aphids on snapdragon, the pine bark aphid, and the following scale insects: European elm scale, juniper scale, hemlock scale, and the soft brown scale on ivy, camellia, and avocado. For all these, new and improved control measures have been found, and are discussed in the publication. Rates and methods of application are given.

Technical SECTION

Grace Chemical Makes Urea by Pechiney Process

Producing 150 tons of urea per day for fertilizer and plastics, the Memphis, Tenn., plant of Grace Chemical Co., uses the Pechiney Synthetic Urea Process, recently field tested on a semi-commercial basis in France.

In the process, carbon dioxide and ammonia are the raw materials. Carbon dioxide from the monethanolamine stripper in the ammonia unit (part of the plant designed by Foster-Wheeler for Grace) is compressed, preheated. After treatment to remove sulfur and oxygen, the carbon dioxide is compressed to 3,000 psi. and admitted to the autoclave reactor. Ammonia enters the autoclave at this point together with recycle stream of oil-carbamate slurry. The neutral, mineral oil circulating through the synthesis system is the basis for the Pechiney Process. It not only acts as a medium for recycling unconverted ammonia and carbon dioxide but serves as a "heat sponge" and as a corrosion inhibitor.

In the first stage of the two-stage reaction at 3,000 psi., and 350 degrees F., ammonium carbamate is formed. In the second stage, carbamate converts to urea with approximately 40 percent conversion obtained. The mineral oil absorbs heat from this exothermic reaction.

The oil-urea-carbamate mixture is released to 80 psi. from the autoclave. Unconverted carbamate reverts to ammonia and carbon dioxide. These are srtipped from the oil, urea and water in a Raschig ring-packed column. Oil is decanted from the urea solution and pumped to the salt-oil reactor.

Unreacted ammonia and carbon dioxide recombine to carbamate in this salt-oil reactor. Solid carbamate forms on an agitated surface of oil, maintained at low temperature and 75-105 psi., formed by the action of rotating shafts on which are mounted a number of dispersing disks. Part of the carbamate slurry, a fine matrix of ammonium carbamate in oil, is pumped back to the reactor; part back to the autoclave.

The urea solution goes to a vacuum evaporator, where it is dried to about 0.5 percent moisture and sent molten at 270 degrees F. to the top of the 200 ft. high prilling tower. Pellets are cooled, dusted with clay and bagged for fertilizer. "Urea Via the Pechiney Process," *Chemical Engineering*, April, 1955.

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Control of Cigarette Beetle

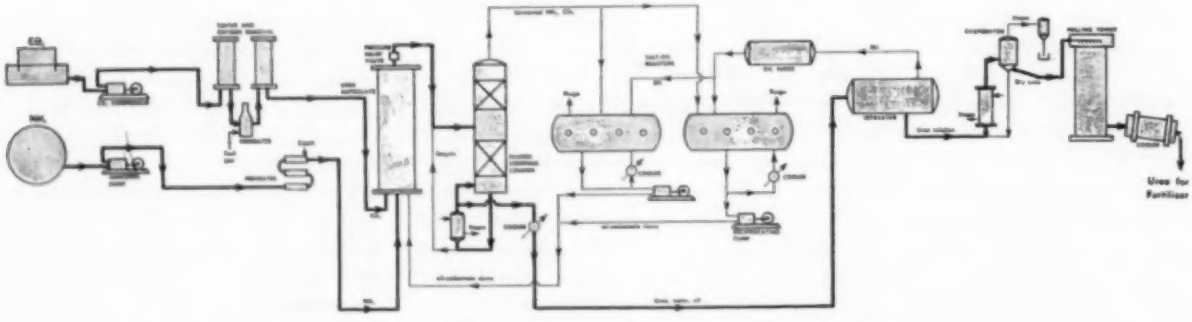
Experiments show that 90 per cent of the flight activities of the cigarette beetle, as indicated by trap catches in 5 untreated tobacco warehouses, occur between 2 p.m. and 2 a.m. 77 per cent of the average catch of 230,576 beetles during the 12-hour period from 2 p.m. to 2 a.m. was taken between 5 and 11 p.m., and 60 per cent between 6 and 10 p.m.

In 5 warehouses treated daily during the late afternoon with a pyrethrum aerosol, the peak catches did not occur until about 8 p.m. The low catches prior to 8 p.m. reflect the degree of control by the aerosol. It is evident, however, that large numbers of beetles escaped the aerosol and were active after the period of the treatment. J. Tenhet, USDA Buln. AMS-49.

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Dusts for Cabbage Worms

Although DDT dusts and sprays have controlled the imported cabbage worm successfully the past 10 years, the pest has now shown resistance to applications of the chemical. Connecticut Agricultural Experiment Station has tested DDT, toxaphene, Dilan, dieldrin, isodrin and endrin against the imported cabbage worm by diluting each chemical with pyro-



Flow Sheet: Urea for Fertilizer by the Pechiney Process

phyllite (Pyrax ABB) to the required concentration and applying dust at the rate of approximately 32 lb. per acre.

Best control of the pest was obtained with Dilan and endrin, both of which gave approximately 98 percent reduction in larval population when used at concentrations of one percent. Next most effective material was DDT and an adequate (95 percent) control resulted from the use of a five percent dust. Toxaphene, dieldrin and isodrin were slowly effective and it was not until the larvae became larger that they acquired lethal quantities of the material and died.

Evidence points towards the use of two or more insecticides in the control program. Since wide variations in tolerance levels to DDT of imported cabbage worm populations can and do occur, a change to a pesticide other than DDT or in addition to it, for controlling this pest is indicated. "Dust Insecticides for the Control of the Imported Cabbage Worm," G. A. Wheatley, Connecticut Agricultural Experiment Station, Bulletin 590, March, 1955.

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Superior Mask Filter

New filters suitable for use by personnel handling the most toxic insecticides have been developed and tested by USDA scientists, and are on the market. Three products, glass wool impregnated with resin, fine-fiber wood pulp, and fine-fiber asbestos, will satisfactorily filter out dangerous amounts of the phosphate-type systemic insecticide, demeton.

Laboratory tests showed that the new wood-pulp filter allowed enough demeton to penetrate into the test chamber to kill only two of 116 aphids, and 13 of 148 adult mites; impregnated glass wool 0 of 232 aphids and 15 of 111 mites; and asbestos, 0 of 163 aphids and 13 of 141 mites. In comparison, normal fine-dust filters equipped with activated-charcoal cartridges (which provide satisfactory protection against chlorinated hydrocarbon and some phosphate insecticides) allowed enough demeton penetration to kill 196 of 199 aphids and 98 of 105 adult mites.

Systemics Tested On Cotton

Cotton-Belt-wide field evaluation of two new experimental systemic insecticides that appear very promising is now in progress.

Speaking before the American Cotton Congress at Harlington, Texas, K. P. Ewing, head of USDA's cotton insect research program, identified the test chemicals by code numbers as 3911 and 12008. Both are phosphorus compounds. The experimental plantings range in size from one-tenth acre to 10-acre plots.

Entomologists of USDA's Agricultural Research Service, will compare the ability of these materials to control such early-season cotton pests as thrips, aphids, and spider mites with results (1) on similar, but untreated cotton fields, and (2) on cotton sprayed with presently recommended insecticides. In areas where the boll weevil occurs, studies will also be made to determine the effect of these systemics on over-wintered weevils.

Dr. Ewing said that he expected these Belt-wide experiments to supply considerable information concerning the field use of systemics. Systemic control of cotton insects cannot be employed by growers until research has shown how these materials can be used without hazard to persons who apply them or to cotton plants, he said.

Compound 12008 underwent limited field testing last year. The potential of 3911 was learned in laboratory and greenhouse experiments carried out last year by USDA and the Texas Agricultural Experiment Station at College Station, Texas. Against some insects 3911 appeared to be more effective than 12008.

In the College Station tests, the two organics were equally effective against cotton aphids, spider mites, and the salt marsh caterpillar, providing 9-week control of the first two insects and 2-week control of the last. Against thrips and the boll weevil, 3911 proved to be effective for 7 weeks, 12008 for about 5 weeks. In these laboratory tests last year and in the field trials this year, the two systemics were mixed with activated carbon and applied as a cotton-seed treatment.

Tests showed that these particular systemic materials were not as readily translocated when applied as foliage sprays as when they were applied as seed treatments.

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Borax Checks Beet Dry Rot

Black spot or dry rot of beets can be controlled by correcting a deficiency of boron, according to Charles B. Sayre, Cornell University Experiment Station. The addition of small amounts of borax can compensate for the deficiency, usually found in alkaline soils or soils recently limed. *Boron-O-Gram*, Pacific Coast Borax Co., April, 1955.

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CFA Fertilizer Handbook

The Soil Improvement Committee of the California Association reports that the second edition of the *Western Fertilizer Handbook* is now out. Twelve chapters cover western agriculture and attitudes; soil and water, organic matter; inorganic vs organics; the plant—the cell; plant food elements; diagnostic tests for soil and crop problems; commercial fertilizers and agricultural minerals; use of fertilizers; western laws relating to fertilizing materials; history and purpose of California Fertilizer Association; and economic importance of fertilizers. The Handbook sells at $1.00 per copy. Write to the California Fertilizer Association, 475 Huntington Drive, San Marino 9, California.

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New Dust for Sheep Ticks

Complete control, after one treatment with 1½ percent dieldrin, of sheep ticks can be obtained, reports Robert Pfadt, Wyoming Agricultural Experiment Station. Dusts used previously "wore out" too quickly to kill hatching ticks and often left some older ones alive to breed more pests. Dusting all sheep with dieldrin once after shearing will kill ticks. Tests by the station have gained federal Food and Drug Administration approval for using the dust. Wool held dieldrin up to 86 days after dusting. SCAN, Shell Chemical Agricultural News, May, 1955.

Study Yellow Clover Aphid

U. S. D. A. entomologists have mapped out an expanded research program for better control of the yellow clover aphid, a pest that has recently caused extensive damage to southwestern alfalfa fields. The program will stress studies of the various insecticides, particularly systemics, experiments in biological control, and development of resistant varieties of alfalfa.

Although fairly effective control of the aphid has been obtained in the past with parathion and malathion, the need for frequent applications—one or two per cutting of alfalfa — makes the method extremely costly. Consequently, a cheaper insecticide or new method must be developed.

The yellow clover aphid seriously damaged alfalfa for the first time last year in Arizona, California, Nevada and New Mexico. Though found extensively for many years on clover in the U. S., the aphid did little economic damage prior to 1954. In that year it caused an estimated $4 million loss in alfalfa production in New Mexico alone. Losses to growers in Arizona were estimated at half a million dollars, and in California at more than $300,000. This year the pest has been found also in Kansas, Oklahoma, Texas, and Utah.

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Dalapon for Cotton Grasses

Used as a directed spray, dalapon has shown promise for controlling annual grasses in California cotton. Yield was not reduced in tests, even in the absence of weeds.

Work in Mississippi in 1953 was concerned with the use of dalapon for the control of grasses in cotton in pre-emergence applications. Mid-season directed spray applications of dalapon to 24" cotton and 3" crabgrass controlled the grass successfully without deleterious effect on the yield. However, overall sprays on very young cotton and germinating crabgrass controlled the crabgrass but injured the cotton, even at the rate of two pounds per acre.

Experiments in California in 1954 were made to determine the effect of dalapon applications at mid-season and "lay-by" on the yield, maturity rate, and seed and fiber qualities of cotton. Quantities of from 1½ to nine lbs. per acre were applied as a spray. Results show that yield is not reduced by "lay-by" treatments, but mid-season applications may result in some degree of yield depression. In weedy cotton, the benefit from weed control might overcome such yield reduction. "The Control of Annual Grasses in California Cotton with Dalapon" A. W. Swezey and J. R. Fisher, *Down to Earth*, Dow Chemical Co., Summer, 1955.

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Cement Dust: a Fertilizer?

Mineral composition of cement dust, its high solubility in water and the percent citric acid indicate that the dust is a good fertilizer, according to a report from research workers in Poland. It is believed that an acid soil will be able to dissolve the silicates solution in two percent citric acid and later precipitate silicon dioxide in colloidal form which will cement the particles of soil, thus conditioning it. Chemical Characteristic of Cement Dust (from cement plants) and Their Value for Agriculture, *Cement-Wapno-Gips*, 11(20), 62-4-(1955): thru *Chemical Abstracts*, Vol. 49, No. 12, p. 8544.

In other preliminary experiments on cement dust from electrical precipitators, it was shown that dust recovered from a Cottrell electrical precipitator is a good potassium and calcium fertilizer. Pots were watered, during experiments, with distilled water up to 60 percent of the maximum water capacity of the soil, and 11 seeds of *Helianthus annuus* and *Lolium multiflorum* were planted in each pot. After six weeks green was cut off and weighed. Results showed that the weight of green from the pot containing no fertilizer was 19.7 g.; from a pot containing KCl fertilizer (equal to 0.6g. K_2O) the weight was 46.9 g.; and from the pot treated with cement dust (0.6 g. K_2O) the weight was 98.2 g. Preliminary Experiments on Value of Cement Dust from Electrical Precipitators as Potassium Fertilizer, *Cement-Wapno-Gips* 11(20), 57-62(1955); through *Chemical Abstracts*, Vol. 49, No. 2, p. 8544.

Selective Weed Control

Triherbicide IPC (containing 50 percent isopropyl phenylcarbamate) and Triherbicide NIX (containing 85 percent sodium isopropylxanthate) have been applied in dosages of 5,10,15, and 20 kg./ha. of either IPC or NIX alone or in any combination for treatment of strawberries, cauliflower, beans, peas, lucerne, clover, brussels sprouts, flax, tulips, hyacinths, narcissuses, and gladiolas. In general, sodium isopropylxanthate kills dicotyledons, and isopropyl phenylcarbamate the monocotyledons, with preference; thus the mixtures must be selected for each crop treated. For instance, beans must be treated with mixtures low in sodium isopropylxanthate.

Isopropyl phenylcarbamate kills dicotyledons also, but in the seedling stage only; therefore, it must be distributed well in the soil. With plenty of water, it acts slowly but has a good residual effect. Rain after application enhances its efficiency. It has a great potential as a selective weed killer, either per se, or in mixtures with sodium isopropylxanthate, sodium 2,4-dichlorophenoxyethyl sulfate, maleic acid hydrazine, 2,4-dinitro-o-cresol, or 2,4-dinitro-6-sec- butylphenol. Selective Weed Control with Isopropyl Phenylcarbamate and Sodium Isopropylxanthate, F. H. Feekes, N. V. Fabriek Chem. Producte, Vondelingenplaat, Netherlands; through *Chemical Abstracts*, Vol. 49, No. 12, p. 8547.

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Tobacco Anthracnose in Tenn.

Tobacco anthracnose, a fungus disease found in Tennessee in the last few years, this year has left its natural habitat in plant beds and moved into fields. According to information received by Dr. J. O. Andes, U-T Experiment Station plant pathologist, a half dozen counties, chiefly in middle Tennessee, have reported this new development.

Lightly regarded in the past, tobacco anthracnose caused damage to seedlings, and usually was controlled in plant beds with such chemicals as zineb or ferbam.

One reason for the spread this year, was excessive rains. Cool nights

contributed. However, tobacco anthracnose had built up unnoticed because of minor damage until a growing season which was conducive to a spread.

In the bed, anthracnose is characterized by white leaf spots that may cause death of leaves and young plants. In the field, anthracnose can cause stem cankers that kill plants and distort growing buds and leaves. So far, anthracnose has been found in middle Tennessee and a few fields in east Tennessee. All kinds of tobacco are susceptible, and there are no known resistant plants developed.

Dr. Andes recommends, when anthracnose is found in the field, to rest the land at least a year. Beds should not be seeded near those affected the previous year. Anthracnose can spread by various means, and particularly by drainage, he said.

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New Phosphatics for Cotton

Bayer 16259 (benzotriazine derivative of an ethyl dithiophosphate) found in a screening program for new insecticides for use on cotton, is a promising new compound for control of the boll weevil. Field tests indicate it to be considerably more effective than toxaphene. The methyl homolog of 16259, or Bayer 17147 (benzotriazine derivative of a methyl dithiophosphate) was tested also. This compound (17147) was effective against both pink bollworm adults and larvae, and in a late-season field-plot test, gave much better pink bollworm control than DDT. It also appeared promising in laboratory tests against the boll weevil, cotton aphid, spider mite, bollworm, cotton leafworm, brown cotton leafworm, flower thrips and cotton fleahopper.

Bayer 16259, in laboratory tests, was more effective than 17147 against the salt-marsh caterpillar, cotton aphid, and spider mite, but less effective against the boll weevil.

Residual toxicity of Bayer 17147 was greater than that of toxaphene. "Two New Phosphate Insecticides for Cotton Insect Control," E. E. Ivy, J. R. Brazzel, A. L. Scales and D. F. Martin, *Journal of Economic Entomology*, Vol. 48, No. 3, June, 1955.

LITERATURE AVAILABLE

PACKAGING FOR SALES IN POLYETHYLENE. A folder listing the physical qualities and characteristics of polyethylene and describing the various types of polyethylene bag constructions that are available. Published by Bemis Bros. Bag Co., St. Louis, Mo.

EFFECTS OF FERTILIZER PRACTICES, COVER CROPS, AND RIDGE CULTURE ON THE YIELD OF ASPARAGUS, by E. P. Brasher. Reports an experiment which was conducted to correct conflicting and inconclusive data and make possible valid recommendations for asparagus production in Delaware. Bulletin No. 311 (Technical), University of Delaware, Agricultural Experiment Station, Newark, Del.

SOIL FACTORS AND FERTILIZER RECOMMENDATIONS, 1955. Recommendations for all Oklahoma crops. Each table includes a column of general remarks relating to soil conditions, factors determining recommendations, variations in required applications, etc. Mimeographed Circular M-267, Agricultural Experiment Station, Division of Agriculture, Oklahoma A. & M. College, Stillwater, Okla.

1955 CROP AND FERTILIZER RECOMMENDATIONS FOR MISSISSIPPI. Contains six pages of tables devoted to pasture crops and eight pages of text . . . covering all other crops. Circular 194, Mississippi State College Agricultural Experiment Station, State College, Miss.

APHIDS AND SCALE INSECTS ON ORNAMENTALS, by John C. Schread. Experimental results indicated efficacy of malathion, isolan and systemics on various ornamentals. Recommended dosages are reported here. "Reinfestation during late May and June occurred repeatedly in trees sprayed with malathion and BHC, but less frequently in those treated with Isolan and 12009" —Bulletin 588, The Connecticut Agricultural Experiment Station, New Haven, Conn.

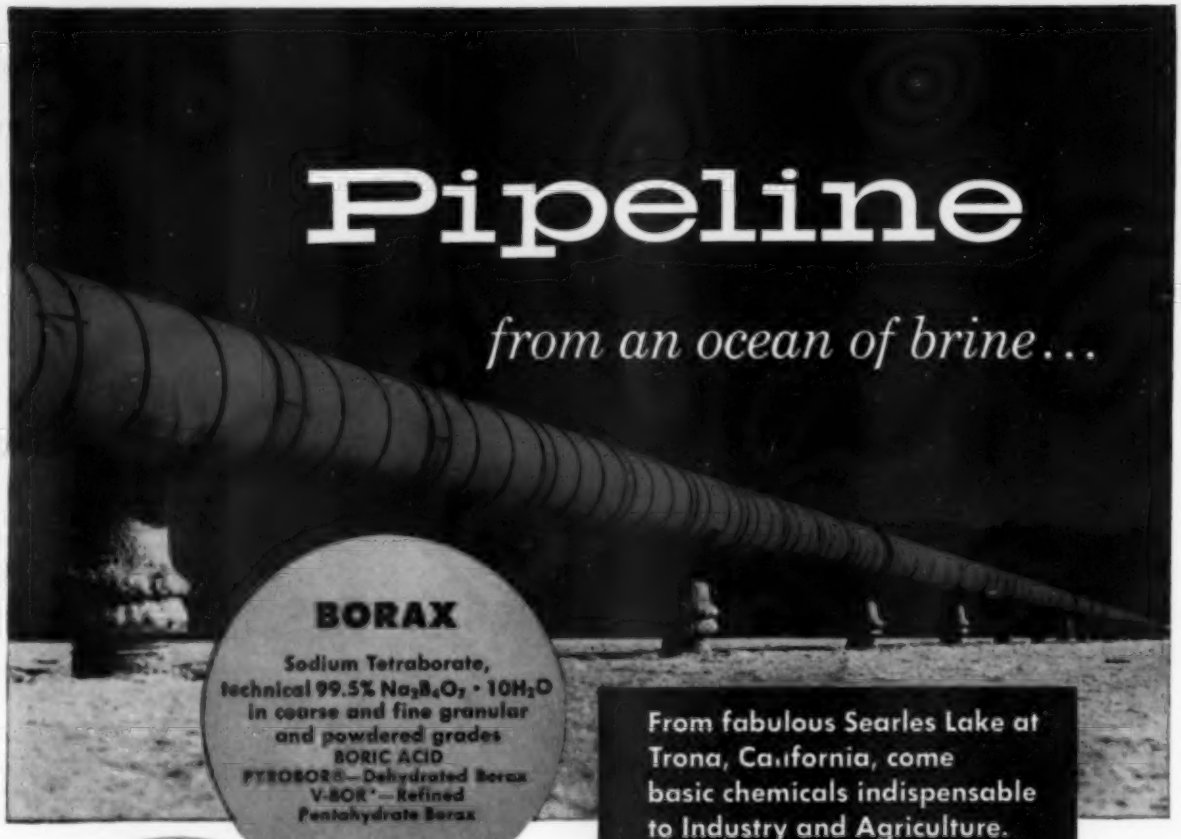
COMMERCIAL FERTILIZERS, REPORT FOR 1954. Classification of fertilizer materials and fertilizer tonnage for the period July 1, 1953 to June 30, 1954, and tables of analyses of commercial chemicals. Tables list name of manufacturer, source of the tested sample, amount of plant food found in sample, and amount claimed. Bulletin 586, The Connecticut Agricultural Experiment Station, New Haven, Conn.

ASSAYING EFFECT OF GROWTH REGULATORS UPON PLANT TUMORS, by Paul E. Waggoner and A. E. Dimond. This study evaluates results of an examination made of the relative efficiency of assaying growth regulator effects upon tumor tissue by means of tissue culture, galls on intact hosts, and galls on storage organs. Bulletin 587, The Connecticut Agricultural Experiment Station, New Haven, Conn.

MITE PESTS OF ORNAMENTALS AND THEIR CONTROL, by John C Schread. Discusses the effectiveness of 13 pesticides in the control of five species of mites attacking ornamentals. All specific miticides were found to be effective in controlling mites at the crawling stage, but during other stages of development effectiveness varies. Bulletin 591, The Connecticut Agricultural Experiment Station, New Haven, Conn.

CHEMICAL WEED CONTROL RECOMMENDATIONS. Recommendations based on cooperative research by Mississippi Agricultural Experiment Station and the U. S. Department of Agriculture. Circular 195, Mississippi State College Agricultural Experiment Station, State College, Miss.

GRANULITE AG-SLAG. Describes a steel industry by-product used for agricultural liming. The material contains the trace elements manganese, sulphur, boron, copper, iron, and zinc in fusion with calcium and magnesium silicate. Issued by The Granulite Co., Chicago, Ill.



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INDUSTRY *News*

Campbell Chem. Name V. P.

Earl W. Kersten was recently appointed vice-president in charge of sales of Campbell Chemicals, Inc., St. Louis, Mo., manufacturers of insecticides, repellents, fungicides, etc. Mr. Kersten was formerly division manager of Dodge & Olcott Inc., for the Atlanta-Georgia area.

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WACA To Berkeley Oct. 11

Annual Meeting of Western Agricultural Chemicals Association will be held Tuesday, October 11, 1955, in Hotel Claremont, Berkeley, California. The all-day program will be announced later. Membership in this Association has increased fifty per cent since January 1, 1955, and C. O. Barnard, executive secretary, expects an attendance of about 150.

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Dow Personnel Advances

Dow Chemical Co. recently announced several personnel advancements in connection with elevation of its Minneapolis and Cincinnati field offices to the status of sales headquarters and establishment of a new office at Buffalo, N. Y.

Marion E. Teller, Edward C. Earley and Eugene L. Martinez were appointed managers, respectively, of the Minneapolis, Cincinnati and Buffalo offices. Mr. Earley previously served with the company at Chicago as supervisor of agricultural chemicals sales.

In other changes, William F. Hardy, formerly a supervisor of agricultural chemicals sales with the Houston office, was named to succeed Teller at Chicago, and Albert Weil, agricultural chemicals salesman with the St. Louis office since 1946, was appointed to take over the position vacated by Hardy at Houston. William L. Corbin will move up to succeed Earley at Chicago.

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Porterfield Joins NPC



William B. Porterfield, Jr., joined National Potash Co., New York August 1 as vice president and sales manager. Mr. Porterfield resigned as assistant sales manager of United States Potash Co., New York, to become associated with the newly formed company, which is jointly owned by Freeport Sulphur Co. and Pittsburgh Consolidation Coal Co.

Mr. Porterfield served with Chilean Nitrate Sales Corporation before going with U. S. Potash in 1947 as sales representative for the eastern seaboard. National Potash is constructing a mine and plant to produce potash from a substantial deposit near Carlsbad, New Mexico.

Richard C. Wells, vice president and controller of Freeport Sulphur Co. is president of National Potash Co.

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N. J. Survey on Beetle

The white fringed beetle has been a serious pest in South Jersey, and according to Dr. L. G. Merrill, Rutgers University, the pest is capable of causing at least as much damage to crops as the Japanese beetle did a few years back. A state and federal control program involving treatment of beetle infested land in South Jersey has been carried out, and a follow-up survey is now being made.

New NH_3 Dealer Assn.

Wisconsin dealers in anhydrous ammonia for direct application completed plans at a meeting in Madison, Wisc., July 11 to form a state trade association. The association, which will be concerned largely with education, anticipates working more closely with state officials and the University of Wisconsin extension division on mutual problems.

Roland Strid of the Strid Grain Co., Green Bay, was named chairman of a committee which will draw up charter provisions and by-laws and set a date for their consideration by the group.

Others on the committee are G. A. Davidson, Coulee Chemical Co., La Crosse; Del Christionsen, Lion Oil Co., Janesville; Robert Howard, Baldwin Liquid Fertilizer Co., Baldwin; and Bruce O'Conner, O'Conner Oil Co., Fond du Lac.

E. W. Thomas of the Farm Service Corp., Boonville, Mo., a past president of the Agricultural Ammonia Institute and chairman of its insurance committee advised the group on how to study their insurance problems. Advice on insurance coverage is available from the A. A. I., Mr. Thomas said.

Frank J. Bishop, chief boiler inspector for the Wisconsin State Industrial Commission discussed the Anhydrous Ammonia Code which the commission will issue later this year. Jack Criswell of Memphis, executive secretary of the national Agricultural Ammonia Institute, assisted the group in formulating its organization plans.

DuPont Names Chicago Mgr.

Thomas J. Desmond has been appointed Chicago district sales manager of the Du Pont Company's Grasselli Chemicals Department. He succeeds W. James Latimore, who will move to Wilmington on special assignment. Mr. Desmond has been Boston district sales manager since 1951.

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Hudson Buys Hammond Stock

M. J. Davis, president of Hammond Bag & Paper Co., Wallsburg, W. Va., announced early in July that the directors of the company have approved a proposal for the transfer of the company's paper bag manufacturing business to Hudson Pulp & Paper Corp. in exchange for shares of the Class A Common stock of that company, such shares to be distributed by Hammond to its shareholders.

The Paper Board Mill of the Hammond company, located at 22nd Street in Wellsburg, is, however, not included in the exchange. It will be taken over by a new corporation to be organized under a new name, by Hammond shareholders.

Hudson will continue the present operation of the bag manufacturing business, with the same Hammond executive, sales and employee personnel. The Wellsburg, Pine Bluff, Arkansas, and Charlotte, North Carolina plants of Hammond will be included in the marketing and distributing pattern of Hudson and it is expected that the activites of each of these plants will be expanded as time goes on. Sales operations as heretofore will be under the Hammond name.

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Calspray Names Cody

California Spray - Chemical Corp., Richmond, Calif., last month named Leslie R. Hamilton to be coordinator of fertilizer operations for the company. Hamilton will ccordinate marketing activities in connection with production by the recently announced 16-million dollar fertilizer plant which is being built in Richmond, California.

Before assuming his new duties, Hamilton served as a supervisor of fertilizer sales for Calspray. Before that, Hamilton worked as operations manager with the Mid-State Chemical Supply Co.

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Bales is Chipman V. P.

The Chipman Chemical Company, Inc., Bound Brook, N. J., announces that Irvin W. Bales has been elected a vice-president of the company. Mr. Bales will continue as director of research and technical service, also in general charge of new products development.

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Shell Urea Plant in Calif.

Shell Chemical Corp., New York, is planning to build a new urea plant at Ventura, Calif. Construction will start shortly and it is expected that the plant will be in operation by September, 1956.

The new plant will have a capacity of more than 100 tons a day. It will secure its raw materials, ammonia and carbon dioxide, from the adjoining Shell ammonia plant at Ventura.

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British Scientist at Conn. Sta.

Dr. Mary Franklin, of the nematology department, Rothamsted Experimental Station, Harpenden, Herts, England is working with the plant pathology staff of the Connecticut Agricultural Experiment Station, New Haven, Conn. on a 3-month appointment.

Dr. Franklin will study the tobacco cyst nematode and also the association between meadow nematodes and brown rootrot of tobacco. Other investigations will include a survey of possible root damage to fruit trees by nematodes, and research to find more practical ways of growing nematodes for experimental work in the station laboratories.

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Western Phosphates, Inc.

Western Phosphates, Inc., Garfield, Utah, announced plans last month for expansion of its multi-million dollar ammoniated phosphate and treble superphosphate plant to be completed early in 1956.

New Pacific Fert. Plant

Formation of Phillips Pacific Chemical Co. which will construct an ammonia fertilizer plant in southeastern Washington, was announced recently by the Phillips Petroleum Co. and Pacific Northwest Pipeline Corp. which will jointly own the newly formed firm.

The initial unit of the new plant will produce 200 tons daily of anhydrous ammonia.

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Chem. Storage Plant Sold

Chemical Producers Service, Inc., has acquired the plant at Port Reading, Woodbridge, N. J., formerly owned by Petroleum Solvents Corp. The new owner will operate the plant as a liquid chemical storage terminal with facilities for private label packaging, drumming, canning, blending, laboratory research and formula development.

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Francis Joins Black Leaf

Appointment of William B. Francis as a sales representative for the Black Leaf house-and-garden line of pest-control products in Texas was announced by Diamond Black Leaf Co., Cleveland, Ohio.

Having already assumed his new duties, Francis makes his headquarters at Dallas, Texas. His varied business experience includes four and a half years in a sales capacity with Geigy Agricultural Chemicals at McGregor, Texas.

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ESA Revises Pesticide List

The Committee on Insecticide Terminology of the Entomological Society of America has revised and brought up to date the list of names of insecticides for use in the *Journal of Economic Entomology*. This list is confined to the principal organic compounds that have been developed as insecticides in recent years, the chemical names of which are too long for convenient use. For identification of these materials, the list includes their chemical definitions and other designations that have been given to them in the literature and elsewhere. The approved common names of a few fungicides are also included.

Bemis-Norfolk A. Mgr. Retires

L. R. Horger, assistant manager of the Bemis Bro. Bag Co. plant at Norfolk, Virginia, has retired at the end of 30 years of Bemis service. He plans to devote his time to the operation of his farm in the Piedmont Section of Virgina.

Mr. Horger joined Bemis as office manager at Ware Shoals, South Carolina, where Bemis operated a bag factory prior to the purchase of the Norfolk plant. When Norfolk was acquired, Mr. Horger was transferred there and was placed in charge of sales. He was made assistant manager in 1943.

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Jenson Joins Am. Potash

James H. Jensen has joined American Potash & Chemical Corporation as an advisory engineer at the company's main plant at Trona, Calif. Prior to going with American Potash & Chemical Corporation, Jensen was associated with the Ralph M. Parsons Co., of Los Angeles.

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Hold S. W. Fert. Conf.

The Southwestern Fertilizer Conference and Grade Hearing, held July 13-15 at the Buccaneer Hotel, Galveston, Texas, featured reports by Dr. Russell Coleman, Washington, D. C. and Dr. R. C. S. Young, Atlanta. Control officials of Louisiana, New Mexico, Oklahoma and Texas cooperated in presenting the annual fertilizer grade hearing during the session on July 15.

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USDA Handbook for Gardeners

"Insects and Diseases of Vegetables in the Home Garden," a new publication, was issued early in July by the U. S. Department of Agriculture. It contains four-color illustrations, 45 black-white drawings of insects, and text briefly describing more than a hundred insects and diseases that attack vegetables. It should help home gardeners to recognize the more common pests.

To control them, the publication recommends insecticides and fungicides that recent research has found most effective, safe, and economical—the ready-mixed dusts and easily-prepared sprays that are most generally available and most widely useful in home gardens.

Single copies are available from the Office of Information, U. S. Department of Agriculture, Washington 25, D. C. Ask for Home and Garden Bulletin No. 46.

The new handbook supersedes "Vegetable Gardeners' Handbook of Insects and Diseases."

NH_3 Plant at Richmond, Calif.

Construction of a 300 ton per day anhydrous ammonia plant was started recently at Richmond, Calif. for the Standard Oil Co. The new facility will be part of Standard's multi-million dollar petro-chemical installation located at Richmond. A large proportion of the output of the new plant will be used in the manufacture of complete fertilizers.

New Granulation Process Demonstrated at "Open House"

A NEW fertilizer granulation process which reportedly cuts formulation costs considerably — developed jointly by Spencer Chemical Co., Kansas City, Mo., and the Ark-Mo Plant Food Co., Walnut Ridge, Ark. — was announced last month at the Ark-Mo plant. Fertilizer manufacturers from 24 states and Canada attended a three-day "Open House" to view the plant in action and receive details on the process.



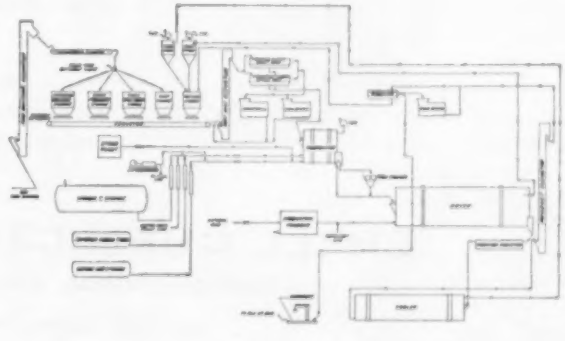
The Ammoniator-Granulator (at top in the picture) is the special feature of the Ark-Mo plant, which was designed by Spencer Chemical Co. In the foreground is a conventional drier.

The granulating operation, designed and set up jointly by the two companies, appears to offer a combination of better quality and decreased cost. In experimental runs, Ark-Mo has been successful in producing 14-14-14 which derives all the nitrogen from a 37 per cent nitrogen solution, departing from the conventional procedure in which it was necessary to obtain some of the nitrogen from more expensive ammonium sulphate.

Complete data will be developed later on other grades, a high 1-4-4 ratio, for example.

Representatives of Spencer and Ark-Mo emphasized that they are by no means the pioneers in this granulation movement. Some months ago, Spencer technical people developed additional information on granulation to supplement the findings of private companies, the USDA and TVA.

Critical factor is accurate control throughout the process. Automatic control of material flow, together with automatic recording of temperatures at various locations aid the system. Raw materials are weighed separately by gravimetric feeders. A conveyor belt and elevator carries materials to screens and crushers, where oversized are ground to pass a 10-mesh screen.

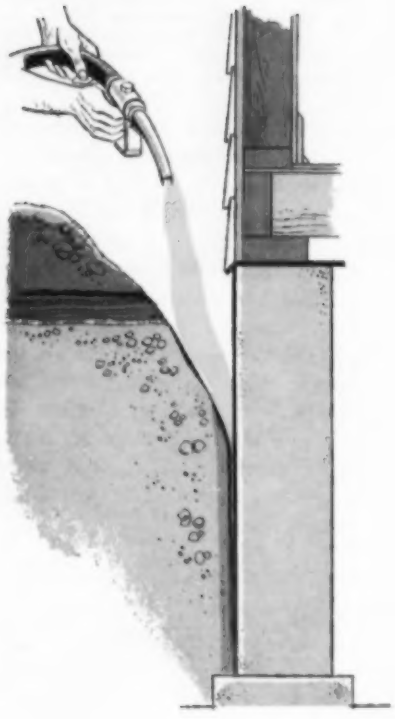


Flow Diagram of Ark-Mo Fertililzer Granulation Plant.

dieldrin

...the powerful, modern insecticide...

NOW ACCEPTED FOR TERMITE CONTROL



tests show dieldrin offers long-lasting protection, effective control

Now pest-control operators can offer customers dieldrin . . . the modern insecticide for effective, long-lasting termite control. Dieldrin has been tested and accepted for termite treatment.

long-lasting effectiveness

Dieldrin is famous for its long residual action and chemical stability . . . even in soil with high alkaline or acid content. Current information shows it will remain effective in *any type of soil for years!* Dieldrin is a more effective means of termite control than structural barriers, because dieldrin kills termites if they eat, touch, or breathe it.

greater assurance for your customers

Now you can offer your customers better protection against termites over a longer period of time. In many areas, your customers already know about dieldrin's effectiveness on soil insects that attack lawns and ornamentals.

simple procedure

Homes can be protected from termites easily and quickly with an application of dieldrin along foundations, according to label instructions.

SHELL CHEMICAL CORPORATION

AGRICULTURAL CHEMICALS DIVISION

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The liquids are added in an ammoniator-granulator, the only equipment of special design in the Ark-Mo plant. All nitrogen is derived from ammoniating solutions. From the ammoniator, the material flows to dryer, cooler and finished product screens. Fines are collected and weighed back into the system. High-nitrogen grades are coated with diatomaceous earth on the way to storage. Low-nitrogen grades go direct from process to storage by a conveyor belt.

Spencer advises that further information on other fertilizer grades will be developed in the near future.

•

Canadian Fertilizer Expansion

Establishment of a new fertilizer plant near Winnipeg, Manitoba, and further development of Saskatchewan's potash reserves are reported in an editorial appearing recently in Toronto's *Financial Post*.

According to the *Post*, the Manitoba plant will employ a new German manufacturing process, and will use natural gas from Alberta, potash from Saskatchewan and sulfates from the Gulf of Mexico. Present plans call for a $25 million plant, producing the equivalent of a full trainload of fertilizer per day for markets in Eastern Canada, the Prairie provinces and Mid-West U. S. A.

•

Irrigation Research Program

Olin Mathieson Chemical Corp., Baltimore, announced recently, a program of research on the agronomic and technical aspects of irrigation. Supervised by the company's irrigation department, of which Thomas W. Crockett is manager, the program will be directed by Dr. G. G. Williams, Purdue University agronomist, who joins the company August 1 as manager of irrigation research and planning. While the program is expected to develop considerable data of benefit to farmers, it also will serve to guide the development of Olin Mathieson's irrigation engineering and marketing programs.

On the basis of experiments started in 1943, the Mathieson system of supplemental irrigation was introduced in Eastern markets at the end of World War II.

Spencer Advances Van Aken

Spencer Chemical Co. announced in mid July the appointment of W. D. Van Aken, formerly Kansas-Oklahoma sales representative, to the position of mid-west district sales manager. The district is comprised of Missouri, Kansas, Oklahoma, Nebraska, Texas and Colorado. Mr. Van Aken, who has held the sales position in Kansas and Oklahoma since 1948, will be replaced in Kansas by J. R. Crail, who has been assistant to Claude Byrd, manager of Spencer's agricultural chemicals sales.



W. D. Van Anken, newly appointed mid-west district sales manager for Spencer Chemical Company.

•

Plans NH_3 Marketing Expansion

Expansion of Mid-South Chemical Corp.'s organization in the mid-west and south for the marketing of anhydrous ammonia was announced in mid-July. It was announced at the same time that Continental Oil Co. and Cities Service Co. have acquired an interest in Mid-South Chemical Corp., Memphis.

Under the expanded program, Mid-South plans to market anhydrous ammonia, over a wide area in the central part of the country. The company's source of ammonia will be a plant at Lake Charles, La., which will receive its raw materials from the Conoco and Cities Service refineries at Lake Charles.

•

Fertilizer Price Bulletin

A bulletin giving revised index numbers of prices of fertilizer materials, by Paul R. Poffenberger, has been issued by the Dept. of Agricultural Economics and Marketing, University of Maryland Agricultural Experiment Station, as Miscellaneous Publication No. 230.

The bulletin is based on a study financed partly by the American Potash Institute, Inc. It carries a revision of index numbers first published in 1942. Some of the new materials incorporated in this revision are triple superphosphate, nitrogen solutions, anhydrous ammonia and ammonium nitrate.

•

Pesticide Tolerance Amendment

The Food and Drug Administration announced in mid-July the adoption of the following amendment to its regulations relating to tolerances for pesticide chemicals on vegetables, regarding the fees applying to the setting of tolerances:

(d) Each petition or request for an exemption of a temporary exemption from the requirement of a tolerance, a temporary tolerance, or the amendment or repeal of a tolerance or exemption shall be accompanied by a deposit of $500, unless it meets the requirements of subparagraph (1) or (2) of this paragraph.

(1) Such deposit is not required when, in connection with the change sought under this paragraph, a petition or request is filed for the establishment of new tolerances to take the place of those sought to be amended or repealed and a deposit is made as required by paragraph (a) or (b) of this section.

(2) A request for a temporary tolerance for a pesticide chemical which has a tolerance for other uses at the same numerical level shall be accompanied by a deposit of $50 for clerical handling and initial administrative review plus $50 for each raw agricultural commodity on which the temporary tolerance is sought.

•

New Mississippi Fertilizer Plant

Tennessee Corporation has started construction of a new $150,000 fertilizer manufacturing plant at New Albany, Miss. The plant is scheduled for completion by the latter part of 1955.

•

To Build Sulphuric Plant

Consolidated Chemical Industries Inc. have announced plans for construction of a large contact sulfuric acid plant at Le Moyne, Alabama. The plant, to cost -2 million, is expected to be completed by mid-1956.

•

U. C. Advances Gates

A. P. Gates, Jr., of Richmond, has been advanced to assistant to vice president C. Cecil Arledge of the Virginia-Carolina Chemical Corp., Richmond, Va. He succeeds E. Y. Base, who will retire after 45 years with the company.



TENNESSEE CORPORATION

TRIPLE SUPER-PHOSPHATE

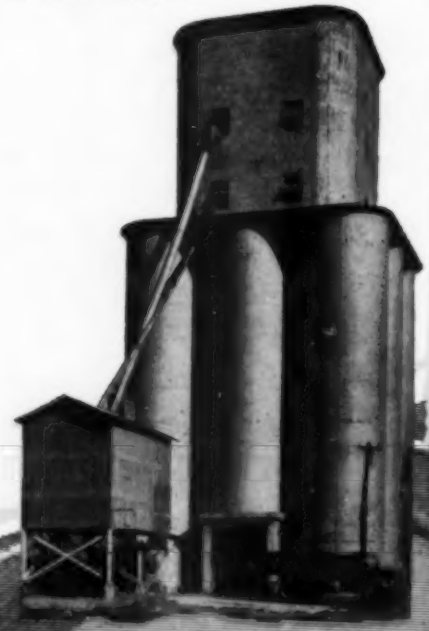
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3. PROMPT SERVICE TO MEET EVERY REQUIREMENT

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Southern Fertilizer Officials Elect Etheredge



Executive Committee of the ASFFCO: front row: R. W. Ludwick, vice president; M. P. Etheredge, president; and B. Poundstone, secretary-treasurer.

Back row: E. A. Epps, Jr., past president; H. H. Hoffman, Bruce Cloaninger and N. F. Franklin. E. W. Constable, not in picture, is also on the executive committee.

THE Association of Southern Feed & Fertilizer Control Officials concluded its 13th annual convention at the Jung Hotel, New Orleans, on June 24, with the election of the following officers for the coming year: president, M. P. Etheredge, State College, Mississippi: vice president, R. W. Ludwick, State College, New Mexico; secretary - treasurer, Bruce Poundstone, University of Kentucky, Lexington.

N. L. Franklin, Virginia Department of Agriculture, Richmond, was elected to the executive committee and was made chairman of that committee. Others on the executive committee, in addition to association officers are: Bruce Cloaninger, Clemson, S. C.; H. H. Hoffman, Department of Agriculture, Tallahassee, Fla.; E. W. Constable, Department of Agriculture, Raleigh, N. C. and Ernest A. Epps, Jr., Department of Agriculture and Immigration, Baton Rouge, La.

E. Boyd, Virginia Carolina Chemical Corp., Richmond, outlined to members and guests, "The Basis for Determining Fertilizer Grades." Mr. Boyd indicates that

"The whole problem resolves itself into knowing the crop needs, what the soil has to offer, and the amount and kind of fertilizer to balance the ration. That these conditions can be satisfied with relatively few grades is being recognized throughout the fertilizer belt. Some of the advantages of a few rather permanent ratios and higher grades over a multiplicity of constantly changing grades are: (1) *less* storage space required in factories, (2) *less* price spread between low and high grades, (3) *encourages* farmers to follow recommendations, (4) *less* cost per pound of plant food in higher analysis goods, (5) *easier* handling on loading platform, (6) *savings* in registration, tag and bag printing, record keeping and chemical control and, (7) creates more confidence on part of consumer.

"The experiment station *gets the facts,*" he said, "the educational groups *carry the message,* and industry *supplies the essential materials.* To be practical, the facts and the message must be such that industry can build the grades out of the materials available. This may mean compromise and coordination of effort among research, industry and educational groups to the end that our farmers may be served."

The 3-day meeting opened on June 22nd with addresses by E. A. Epps and D. L. Pearce, both of the Louisiana Department of Agriculture; M. B. Sturgis, Louisiana State University and E. C. Boudreau, Food & Drug Administration, New Orleans.

Other reports presented at the sessions included: "Feed Law and Custom Mixing," by Fred Brock, Texas Agricultural Experiment Station; "Building A Good Broiler Ration," A. B. Watts, Louisiana State University; "Feed Control Problems Arising From Introduction of New Nutrients as Ingredients to the Feed Industry," J. R. Couch; and "Urea for Ruminant Feed," Allen O. Tillman, Oklahoma A & M College.

It was announced that the next annual convention of the Association of Southern Feed & Fertilizer Control Officials will be held at the Hotel Roanoke, Roanoke, Va., June 28-30, 1956.

•

Lindane Tolerance Set

The Food and Drug Administration recently announced the following tolerance for lindane residues:

"Where a tolerance of five parts per million for benzene hexachloride is set, it shall be deemed applicable to commercial benzene hexachloride, which is a mixture of several isomers. If the gamma isomer, known as lindane, is used exclusively of other isomers, the tolerance shall be ten parts per million." Reference: *Federal Register,* March 11, 1955.

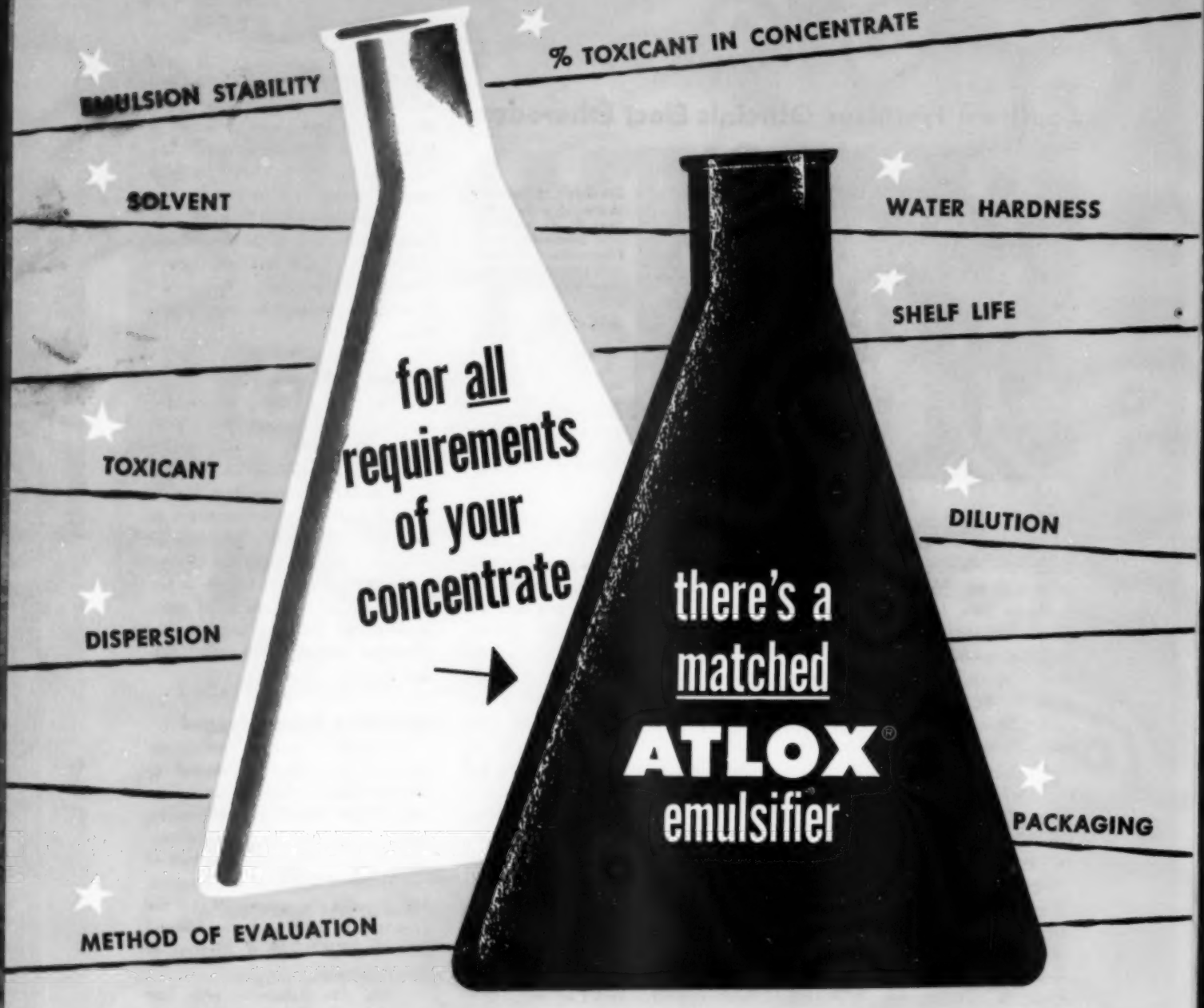
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Gardening Council Formed

Five of the country's largest retail nursery companies, located in western New York, have formed an organization called The Gardening Council, according to an announcement by Paul Newton, chairman of the board of the new organization. Mr. Newton also announced that the presidents of the five companies would constitute the board of directors of The Gardening Council.

The five companies are: Empire Nursery Products Co., Inc., Henry Robbins, president; Knight & Bostwick, Richard Vickery, president; William C. Moore & Co., John Keane, president; Quaker Hill, Inc., Charles Pulver, president; and C. W. Stuart & Co., Arthur Christy, president.

The Gardening Council will offer information on nursery products to consumer groups, nursery groups and other interested parties. It will provide the home owner with information which will aid him in planting and maintaining the land around his home. The Council is located at 130 East 59th Street, New York City.



Naturally, no one emulsifier is going to be best for all concentrate formulations. Each of the ten factors listed here plays an important part in the selection of an emulsifier, if you are to get the one that will be best for you, for each of your formulations.

Atlas representatives can help you in this selection—if they know all your requirements. Backed by a staff of specialists with long experience in the field of agricultural chemistry, and an extremely capable group of research chemists, they are ready to assist you. They can recommend Atlox emulsifiers, or emulsifier blends, which will enable you to give your customer what he wants, and bring him back to you for his future needs.

Just send us complete information about your concentrate, and we'll be glad to recommend an Atlox emulsifier that's tailor-made for your formula.

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Jefferson Transfers to Tex.

Jefferson Chemical Company transferred its headquarters offices and about 50 employees from New York to Houston, Texas, July 1. Offices are now located in the Mafridge Building, 411 Fannin Street.

The Company's main plant is located at Port Neches, Texas, and the research laboratory is at Austin. Sales offices are maintained in New York, Chicago, Charlotte, North Carolina, and Houston.

Jefferson Chemical is owned jointly by American Cyanamid Co. and The Texas Co.

•

Ware Addresses Paris Conf.

Speaking July 1 before the Centenary Congress of the Societe de l'Industrie Minerale held in Paris, France, Thomas Ware, vice-pres., International Minerals & Chemical Corp., Chicago, described operations research as one of the most powerful new tools ever to be placed in management's hands.

One of four Americans to address the Centenary Congress, Mr. Ware predicted it will not be long before we will have exploited present mining methods to where mine staffing is at a minimum.

"Ready to meet that need is a scientific method not yet widely understood in the mining world. The method is operations research. It brings a new dimension to mine management decisions, to the search for the facts behind operating objectives," he said.

Mr. Ware told how operations research was used in connection with dragline operations at International Minerals & Chemical Corporation's phosphate mines at Bartow, Florida.

"Now we have performance standards against which to evaluate our operations, or with which to predict and plan," he said in summarizing results. "We can compare one plan for mining against another, all on paper without the expense of actual field trials. Such plans can be predicted years ahead, backed with confidence. We can even see the effects of machine design on our own business economics. Using our new operations research tool, we are free to synthesize and determine the impacts of changing equipment component designs."

•

V-C Names Gates, Arledge

A. P. Gates has been named assistant to C. Cecil Arledge, vice-president of Virginia-Carolina Chemical



R. A. Jenkins A. P. Gates

Corp., Richmond, Va. Mr. Gates succeeds E. Y. Bass who retired recently after 45 years service with V-C.

At the same time, R. Andrew Jenkins has been appointed manager of V-C's Baltimore sales office. He succeeds H. A. Vernay who retired last month after 46 years as a V-C employee.

Other sales personnel changes effective July 1 include the transfer of Robert G. Kreiling, Jr., from the Savannah, Ga., sales office to the general sales department, Richmond, and the promotion of three men from assistant to manager to the position of assistant manager. They are J. S. Crosby, of the Baltimore sales office, G. F. Flenniken, of the East St. Louis, Ill., sales office, and A. T. Montgomery, of the Birmingham, Ala., sales office.

•

Hold Seminar at Safety Meet

A lecture seminar was conducted by Ralph J. Crosby, Marsh & McLennan, Inc., New York, at the fertilizer section meeting of the Virginia Safety Association, held at Richmond, Va., June 3. Mr. Crosby's talk covered the duties of the plant supervisor in the administration of a safety program, the function of investigations into accidents to prevent further accidents, and some of the reasons that have hindered the safety movement from attaining complete success.

Among the latter Mr. Crosby listed over-emphasis on personal injury and lost-time accidents, and inadequate attention to supervisory problems. According to the speaker, "It is the job of the supervisor to control the performance of those under him. The safety director is in a staff position, but the supervisor has the direct responsibility for seeing that a job is done right."

Conn. Station Field Day

Dr. Donald F. Jones, who invented the double-cross method of hybrid seed-corn production, will be honored at the annual field day to be held at The Connecticut Agricultural Experiment Station's Experimental Farm, Mt. Carmel, August 16. Dr. Jones is head of the Genetics Department at the Station.

Another pioneer in the field of hybrid corn production, Henry A. Wallace, will give the principal address at "Donald F. Jones Day."

Visitors will have the opportunity, as in years past, to see promising developments in plant-breeding research, including freak variations of no immediate commercial value and others that may help to advance further the frontiers of plant science.

•

Discuss Cotton Expansion

The role of farm mechanization in the drive to expand cotton markets will be emphasized at the ninth annual Beltwide Cotton Mechanization conference to be held at Memphis, Tenn., Sept. 7-8. The conference will consider the influence of mechanization on the quality and cost of lint as factors in meeting competition with synthetic products. Additional topics to be covered include the effect of mechanical stripping on production costs, preservation of lint quality in mechanized production, and the impact of public farm research on mechanization.

•

1955 Data on Pesticides

The 1955 edition of the *Pesticide Official Publication and Condensed Data on Pesticide Chemicals* is ready for distribution. This edition contains many of the common trade names under which pesticide materials are encountered in commerce. The number of chemicals covered has been increased to about 175. Of especial interest is the inclusion of official residue tolerances covering those materials for which they have been established.

The book sells at $3.00 per copy. Orders should be sent to A. B. Heagy, at Box HH, Univ. P. O., College Park, Md.

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Conference on Molybdenum at Hopkins

REPRESENTATIVES from the United States, Canada, Australia, Japan and England discussed the function of molybdenum and other trace elements in animal and plant nutrition, nitrogen fixation by legumes, and conversion of nitrates to protein June 22-24, at a conference on Molybdenum in Nitrogen Utilization at the Johns Hopkins University, Baltimore, Md.

"A farmer can expect a yield of three tons of hay when he sows an acre of alfalfa, but he won't get it unless one-tenth of an ounce of molybdenum is available in the soil," Dr. W. D. McElroy stated in opening the meeting.

Legume crops such as alfalfa, clover and soybeans require traces of molybdenum to convert the inert nitrogen of the air into a usable form for protein synthesis by the plant, Dr. Perry W. Wilson of the University of Wisconsin explained. By this fixation process, farmers and ranchers can tap the atmosphere's inexhaustible nitrogen resources at very low cost.

Alfred J. Anderson, Australian agronomist who first demonstrated the practical value of molybdenum on crops, reported that its use on pasturelands has worked a revolution in the agricultural economy of his country. Clover yields have increased from literally nil to as much as three to four tons an acre after application of a few ounces of a molybdenum chemical, Dr. Anderson said.

Last year about 5% of the superphosphate fertilizer used in the state of New South Wales contained molybdenum at the rate of 1½ pounds of molybdic oxide (or the equivalent in sodium molybdate) per ton of superphosphate. This development is proceeding so rapidly that this year more than 10% of all fertilizer in that state will contain molybdenum, Anderson estimates.

Dr. McElroy pointed out that all crops, whether legumes or not, require molybdenum to reduce nitrogen in the plant from the nitrate state to the ammonia form needed to build protein.



Dr. W. D. McElroy (right), director of the McCollum-Pratt Institute, Baltimore, for trace metal research, welcomes Drs. Alick T. Dick (left) and Alfred J. Anderson (center) of Australia to conference on molybdenum in nitrogen utilization.

In discussing developments in the United States, Dr. Albert E. Kretschmer, Jr., of the Everglades Experiment Station in Belle Glade, Fla., reported that molybdenum treatments have recently been introduced in Florida to combat a mineral deficiency disease known as yellow spot of citrus. Many citrus groves lack adequate available molybdenum in the soil, he said. As a result, the trees can't utilize the nitrogen and it accumulates as nitrate in toxic quantities in the leaves, causing the characteristic yellow spots between the veins. Trees lose their leaves and yields are low.

With the new treatment, however, the disease can be entirely cured or prevented. The procedure is to include a sodium molybdate application in the regular spray program at rates of ½ to 1 lb. per acre.

Dr. Kretschmer cited a recent survey of molybdenum deficiencies that showed about 35 molybdenum-starved areas in the United States, over twenty of which have been spotted only in the last two years. All of these are in the East, along the Gulf Coast and in the Pacific Northwest. This is to be expected, Dr. Kretschmer stated, since the acid soils of these regions are most likely to contain molybdenum in an unavailable form.

New Calspray Laboratory

California Spray - Chemical Corp., Richmond, Calif. announced recently the construction of a new bio-screening laboratory in Richmond. The new lab is a part of the company's program for expanded research facilities and will be used to develop new pesticides. The laboratory is scheduled to be in operation by the end of July.

•

Name NAC Program Chairman

Appointment of M. R. Budd, Hercules Powder Co., Wilmington, Del., to serve as chairman of the program committee for the National Agricultural Chemicals Association's 22nd annual meeting at Spring Lake, N. J., Sept. 7-9, was announced recently by Lea S. Hitchner, NAC executive secretary.

Members of the committee are Douglas G. Bennett, Phelps Dodge Refining Co., New York; Silas Besthoff, Faesy & Besthoff, Inc., New York; J. L. Damon, General Chem. Div., Allied Chem. & Dye Corp., New York; L. G. Gemmell, Geigy Chemical Corp., New York; Howard J. Grady, California Spray-Chemical Corp., Washington, D. C.; Charles L. Hovey, Eastern States Farmers' Exchange, Inc., West Springfield, Mass.; Dr. Alfred Weed, Olin Mathieson Chem. Corp., New York; and Wayne Yoder, American Cyanamid Co., New York.

•

New Fert. Plants in Israel

Two fertilizer plants began production of potassium sulphate and phosphoric acid last month near Haifa Bay, Israel. The potassium sulphate plant will produce 14,000 tons annually, the bulk of which is earmarked for export and valued at about $800,000.

Phosphoric acid produced at the other plant will be used to transform phosphates into high quality superphosphates. At present, capacity of the plant is 7,500 tons annually.

A third plant for the production of dicalcium phosphate is now in partial operation, with a potential annual output of 6,000-8,000 tons. Half of this is expected to be exported.

Little to Retire from Rauh

E. Rauh & Sons Fertilizer Co., Indianapolis, Ind. have announced that Leslie E. Little has elected to retire as director and vice president—production of the corporation, effective on or before October 31, 1955. Mr. Little has served with the corporation thirty years. His successor has not been selected.

•

Ivey Buys Texas Fert. Co.

A major interest in Southwest Fertilizer and Chemical Co., El Paso, Tex., was purchased recently by K. B. Ivey, El Paso cotton farmer. The company, with assets valued at approximately $750,000, has branches in Odessa, Pecos, Clint and Lubbock in Texas and Anthony in New Mexico.

The firm manufactures commercial fertilizers at its plant in El Paso and formulates insecticides at its Odessa plant. It distributes its products in West Texas, New Mexico, Arizona, and Northern Mexico.

Officials of the company announced by Mr. Ivey include N. D. MacAllister, sales manager; W. W. Houghton, credit manager; B. M. Luttrell, manager of the El Paso plant; Jack Humberson, manager of the Odessa plant; C. M. Wesson, manager of the Pecos office; Ted Flint, manager of the Clint office; Alton Bailey, manager of the Anthony office; and B. M. Steele, manager at Lubbock.

•

New Costa Rica Plant

Quimicas Agricolas Centroamericanas, Ltda., San Antonio de Belen, Costa Rica, last month dedicated a new insecticide plant capable of producing from 70 to 150 different formulations.

The company will process from 25 to 35 high grade technical concentrates which will then be sold under the Quimagra label throughout Central America. It is expected that a majority of the purchases of technical material will be made in the United States. Plans already call for production of insecticides containing chlordane, DDT, toxaphene, BHC, aldrin, dieldrin, heptachlor. The company will manufacture special formulations following the recommendations of the agricultural departments of each of the Central American countries. Channing J. Frederickson was appointed chief operating executive.

The plant features a Raymond Roller Mill, which produces fine powders—99% passing through a 325 mesh screen.

Preliminary pre-mixing of the insecticides is done prior to their introduction into the mill and the mill then pulverizes to a desired fineness. The use of this mill allows a wide choice of diluents and all materials commonly used can be handled with equal facility. The mill will produce materials with a maximum uniformity of fineness on a continuous basis with little or no variation regardless of length of time the unit is in operation.

Hy-Gro, New Ag. Firm

McCormick & Co., Inc. Baltimore, announced recently the sale of its Agricultural Division, including "Hy-Gro Soluble Plant Food" and "Red Arrow Garden Insecticides," to the newly formed Hy-Gro Corp. of Baltimore.

Principals in the Hy-Gro Corp. are: David H. Fulton, Jr., vice-president of the Plantabbs Corp., is president; Edward A. Hartman, vice-president; F. Jackson Andrews, chairman of the board of the Emerson Drug Co., is second vice-president; Gordon C. Murray, secretary; and W. James Price, IV, treasurer.

Effective June 20th, the Hy-Gro Corp. assumed all operational responsibilities. The general offices of the corporation, are located at 1101 Maryland Avenue, Baltimore 1, Maryland.

Heckathorn in Spruce Budworm Spray Programs

Two tremendous spray projects are being conducted this season in New Mexico and Montana in an effort to minimize damage to western forests from the spruce budworm. Heckathorn & Co., Richmond, Calif., under the direct supervision of E. S. Heckathorn, president of the company, and assisted by E. G. Trimpey, operations manager, have an important part in the project. The Heckathorn organization is supplying insecticides for the spraying of 450,000 acres in New Mexico, having set up a complete formulating plant in Albuquerque, N. M., including a laboratory under the direction of James Brodie, chief chemist, to facilitate the work. Three aerial spraying contractors, Central Aircraft Corp., Yakima, Wash., Johnson Flying Service, Missoula, Mont., and Ace Flying Service, Salem, Ore., are working from four strategically located landing strips in this operation. Dosage is one pound of DDT in one gallon of fuel oil per acre.

Project director, Jim Egan, is cooperating with Dr. Cal Massey, head of the Albuquerque Forest Insect & Disease Laboratory of the Rocky Mountain Experiment Station, who is chief biologist. Biologists, helpers, and radiomen make daily collections and reports to determine best time for spraying operations. It is expected that spraying with DDT will reduce the infestation of spruce budworm by 97 to 99%, and still not be harmful to animals or birds. Special attention is being given to bee colonies and fish hatcheries.

The same operation for spruce budworm was to be repeated in Montana starting about July 1, and covering 168,000 acres. Heckathorn & Co. planned to transport their equipment and personnel to Missoula, Montana to prepare and supply the insecticide used. The planes were to fly from Hamilton and Gardiner, Montana, under the direction of the United States Department of Agriculture, Forest Service. More than 3,700,000 acres in Western forests are infested and will require spraying this season.

Heckathorn & Co. are also involved with the grasshopper spray program, formulating and supplying a spray containing 2 ozs. of aldrin per gallon. Over 350,000 acres are scheduled to be sprayed in New Mexico this season, as well as 131,000 acres in Utah, 50,000 acres in Montana and 41,000 in Nevada.

Standard Oil of Ohio Ammonia Plant Nearing Completion



Construction is progressing on schedule at the Lima, Ohio site of the new facilities for the Petrochemical Department of The Standard Oil Company (Ohio), as is shown in this aerial photograph.

The first unit, a 300-ton per day anhydrous ammonia plant, will be completed late in September. All major pieces of equipment are set, and pipe work is filling in rapidly. The next unit, scheduled for completion November 1st, is a nitric acid unit with a capacity of 180 tons per day. Field construction is under way with much of the equipment on the construction site.

The urea unit, last to be in the field, is scheduled to be in operation in January, 1956. Blending, storage, and shipping facilities will be completed along with the producing unit.

The utility section of the plant will be placed in operation late in July. Laboratories and shops will be completed September 1st. Office facilities are scheduled to be ready November 1st.

W. Phosphates, Appoints Lentz

The appointment of Mr. Elwood I. Lentz as general manager of Western Phosphates, Inc., of Garfield, Utah was announced early last month. Mr. Lentz, had been vice president and plant manager since the founding of the company in 1952. Prior to that he was with Stauffer Chemical Co. He succeeds John Paul Jones, who has resigned.

Western Phosphates, Inc. manufactures treble superphosphate, phosphoric acid and ammonium phosphate at its $5,000,000 plant at Garfield, Utah, just south of Salt Lake City. The company is owned by Kennecott Copper Corp., American Smelting and Refining Co. and Stauffer Chemical Company.

•

Contract With German Firm

An agreement permitting Arthur G. McKee & Co., Cleveland to use several German chemical processes for plant construction in the United States, its territories and in Canada was consummated last month between the American company, Arthur G. McKee & Co., and the Uhde Corp., of New York, a subsidiary of Friedrich Uhde, G. m b H., of Dortmund, Germany. The processes will cover a wide range of operations in the fertilizer field, including manufacture of ammonia and related nitrogen products.

Under terms of the agreement, Uhde "will do primarily process engineering, coupled with sales development, and McKee will engage in the design, procurement and construction of these facilities."

•

USDA Reports Insects Active

The U. S. Department of Agriculture reports increased activity of a number of crop-damaging insects, with alfalfa being hard hit by a number of them in several states.

Grasshopper infestation is reported becoming heavier in Missouri, Arkansas, Oklahoma, Nebraska, and Kansas. The alfalfa weevil, which is doing widespread damage to alfalfa in New Jersey and Delaware, has been reported from Washington for the first time. Early in June North Carolina also reported this pest for the first time. The yellow clover aphid infestation is currently at a low ebb in Oklahoma, Kansas, and Arizona, but continues destructive to alfalfa in the Mesilla Valley, New Mexico.

European corn borer trouble is reported, with damage in Delaware and Massachusetts, egg laying in New Jersey, Illinois, Nebraska and other areas, along with the first economic damage to corn in northern Alabama by this insect. Cool weather has been retarding the borer's activity in Iowa, but in the northern and central areas 10 percent of the corn may suffer first-brood damage, if weather favors egg laying and hatching.

•

Jefferson Appointments

Jefferson Chemical Co., Inc., New York, announced last month the following new appointments to its operations department staff: L. R. Strawn, manager, Manufacturing Div.,; M. H. Holmes, manager, Neches Plant; A. K. May, sales manager; P. R. Monaghan, manager, Technical Service Div.; N. A. Agapetus, manager, Distribution Div.; L. G. Boatright, manager, Market Development Div.; J. J. Glover, assistant to vice president, Operations.

•

New Goodrich Managers

Two managerial appointments in the general chemical sales department of B. F. Goodrich Chemical Co., Cleveland, O., were announced last month by J. C. Richards, vice president in charge of sales.

L. R. Modlin, Jr., has been named manager of general chemicals sales, replacing R. P. Kenney, who recently became European director of chemical activities. J. S. Wolff, formerly biochemical sales development manager, has been appointed as Modlin's successor in the post of field sales manager for the department.

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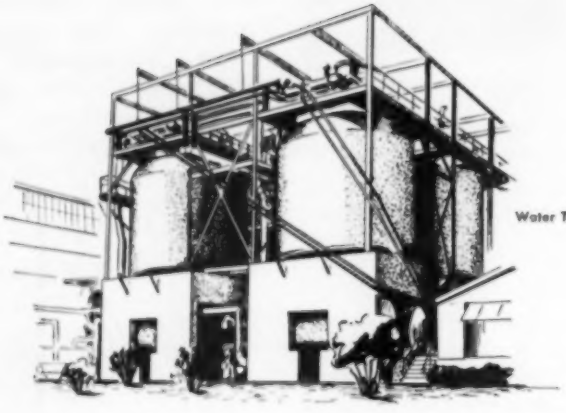
H. R. Krueger Joins Stedman

Harold R. Krueger is the latest addition to the sales staff of Stedman Foundry and Machine Co., Aurora, Indiana. He was formerly with Snyder Chemical Company of Topeka, Kan., and had previously been with Phillips Petroleum Company, Bartlesville, Okla. and International Minerals and Chemical Co., Chicago.

•

Ark. Fertilizer Co. Sold

The Blytheville Fertilizer Co., Blytheville, Ark., has been sold to Arkansas Plant Food, Inc., of Corning, Ark. Operation will continue on the present basis, but distribution of a high nitrogen fertilizer from the firm's Walnut Ridge plant will be added to the Blytheville unit's distribution system.



Water Treating Plant

Crude Sulphur

for Industrial Use

from the properties of

Texas Gulf Sulphur Co.

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Producing Units

- **NEWGULF, TEXAS**
- **MOSS BLUFF, TEXAS**
- **SPINDLETOP, TEXAS**
- **WORLAND, WYOMING**

Cotton Mechanization Conf.

Farm mechanization as it relates to the cotton's industry's competitive position will be discussed in all its aspects at the ninth annual Beltwide Cotton Mechanization Conference, scheduled to be held Sept. 7-9 at Texas A. & M. College, College Station, Texas.

An advance announcement lists the following reports to be delivered: "Facing the Challenges of Mechanization," "A Long-Range Expansion of Farm Research and Education," "Cotton Quality Preservation," and "The Relation of USDA-Land Grant College Research Programs to Cotton's Future Competitive Strength."

Other events featured at the meeting will be a tour of Texas A. & M.'s principal cotton research facilities; a tour of nearby seed farms and a visit to the Temple Experiment Station.

•

AIBS Meeting in E. Lansing

The 1955 convention of the American Institute of Bilological Sciences will be held September 5-9th at Michigan State University, East Lansing, Mich. Among the AIBS societies holding meetings at this time will be the American Society for Horticultural Science; American Society of Plant Physiologists; and the Ecological Society of America.

•

U. S. Potash Names Gordon

United States Potash Co., New York, announced recently the appointment of George S. Gordon as director of research. Dr. Gordon was formerly vice-president of Titanium Zirconium Co., Flemington, New Jersey.

•

To Double NH_3 Capacity

Officials of Sherritt Gordon Mines are giving serious consideration to doubling the capacity of their ammonia plant at Fort Saskatchewan, Alberta. It is anticipated that an early start will be made on the project, increasing production to about 150 tons per day.

•

New IMCC Bldg. in N. Mexico

International Minerals & Chemical Corp., Chicago, announced plans last month to build a new quarter-million dollar office building at its potash mine and refinery near Carlsbad, New Mexico. Work will start immediately and the building is expected to be ready for occupancy about March 1956.



From AC's Photo Box:

(1.) At NPFI meetin White Sulphur: W. B. Copeland, Smith Douglass Co.; R. W. Breidenbach, Commercial Solvents Corp.; W. F. Price and T. Adcock, Swift & Co.; and F. B. Porter, Tennessee Corp.

(2.) At Pacific ESA meeting: C. E. Miller, Colloidal Products Co. and Marshall Magner of Monsanto Chemical Co.

(3.) Also at NPFI meeting: Mr. and Mrs. H. A. Parker and son, Sylacauga Fert. Co.

(4.) J. Culpepper, Spencer Chemical Co.

NH_3 Use Up 17% in 1955

Results of a recent survey indicate that the nation's farmers used 17 per cent more anhydrous ammonia for direct application to their crops during the first five months of 1955 than during the same period in 1954. The survey, conducted by the Agricultural Ammonia Institute and reported in the July-September issue of *Agricultural Ammonia News* reached distributors of agricultural ammonia throughout the nation.

The trend was indicated in reports from distributors whose combined tonnage for the five months account for nearly 10 per cent of the 390,000 tons of anhydrous ammonia that the U. S. Department of Agriculture predicted would be applied by direct application in the 1954-55 fertilizer year. Forty-four distributors reported the distribution of over 35,465 tons of NH_3 during the first five months of 1955 as compared to 30,112 tons for the same period in 1954.

Even with the over-all increase, 18 distributors told of lower sales in the January-May period. In all, the AAI received reports from 54 distributors. Those who turned in incomplete reports were not included in the compillation.

•

David B. Scott Dies

David Burnett Scott, for 18 years western sales manager for American Potash & Chemical Corp. until his retirement in 1952, died of a heart attack on June 20 at his home in Altadena, Calif.

•

Raymond Bag Names Dillon

The appointment of Charles A. Dillon as district representative for Raymond Bag Co. of Middletown, Ohio, was announced last month. He will direct sales of Raymond multiwall paper shipping sacks in Texas, Louisiana and Arkansas, with headquarters in Houston, Texas.

•

Armour Names V.P.

Armour Fertilizer Works, Atlanta, announced late in July that H. V. Miller has been named executive vice-president of the Armour Fertilizer Works and assistant vice-president of Armour & Co.

Add a selling feature to your insecticide with sift-proof

DUOTITE BAGS

You'll give your customers 100% value, your salesmen something to shout about when you pack your insecticide in Duotite bags. The exclusive Shellmar-Betner Duotite feature is a double-folded and heat-sealed bottom, which combined with liners, give positive assurance that your product won't sift. The top can be double-folded and heat-sealed, too; and there is reasonably-priced machinery available for this purpose. Add to sift-tightness the eye-appeal of clean, crisp color-printing by Shellmar-Betner craftsmen; and you have a package that will really build sales.

This is only one of many different packages that Shellmar-Betner now makes for chemical products. If you'd like better flexible packaging for your product, check with Shellmar-Betner.



SIFT-PROOF—
Specially lined and sealed. Duotite bags give double protection against sifting. Customers get full measure of quality.

CONTINENTAL CAN COMPANY

SHELLMAR-BETNER
FLEXIBLE PACKAGING DIVISION
MT. VERNON, OHIO

Sales Offices in Principal Cities

NEWS Brevities

ERNEST HART, executive vice-president of Food Machinery & Chemical Corp., and former president of NAC, has been elected to the board of directors of the Manufacturing Chemists Assoc.

* * *

CALIFORNIA SPRAY - CHEMICAL CORP., Richmond, Calif., is expanding laboratory facilities and office space to be used by the research and development department of the company.

* * *

FULTON BAG & COTTON MILL,, New Orleans, has appointed Charles E. Hendry as sales representative for the Kentucky area.

* * *

JOHN B. DAVIS, manager of industrial sales, Mine Safety Appliances Co., Pittsburgh, was elected president of the Industrial Safety Equipment Association at the group's recent annual meeting.

* * *

ASSETS OF GRIFFIN CHEMICAL Co., San Francisco, have been acquired by the Nopco Chemical Co., Harrison, N. J. The Griffin plant manufactures emulsifiers and related products.

* * *

CITY COMMISSIONERS of Dayton, Ohio, formally approved construction of a $900,000 lime recovery plant at the city's Ottawa St. yards.

* * *

DR. ERNEST SASSCER, an entomologist known for his work in the field of foreign plant quarantine, died recently while visiting at Stillwater, Minn. Dr. Sasscer had been associated with the U.S.D.A. as an entomologist for 49 years previous to his retirement in 1952. He was 72 years old.

HAROLD NOBLE, who retired recently as vice-president in charge of the insecticide division of S. B. Penick



HAROLD NOBLE

& Co., New York, will continue as a member of the Penick board and will serve as a consultant to the company. A veteran of 38 years service with Penick, Mr. Noble had been head of the insecticide department since 1936. He served on the Insecticide Industry Advisory Committee during World War II, and has been a regular attendant at NAC conventions.

* * *

SULPHA FORM CO., manufacturers and distributors of insecticides, has been sold by Karl Goetze to Robert Johnson of Plymouth, Wisc.

* * *

CHARLES W. SHEPHERD has been named plant manager of Federal Chemical Company at Columbus, Ohio. Alvin R. Wagner has been appointed assistant plant manager.

* * *

WAYNE A. LECUREUX has joined Federal Chemical Co. as assistant sales manager of the Columbus, Ohio division.

JOSEPH H. ROCKETT, assistant sales manager of Sinclair Chemicals, Inc., subsidiary of Sinclair Oil Corp., died June 29, 1955, at his home in New York City. He was 47 years old.

* * *

AGSCO, INC., OF GRAND FORKS, North Dakota, manufacturer of agricultural chemicals, was announced as the initial entry in the industry for this year's match book advertising awards competition for the agricultural supply industry.

* * *

CONTINENTAL CAN CO. started construction early last month on a new one-story plant in Midland, Mich., for the manufacture of fibre shipping drums.

* * *

CHARLES MARTIN, vice-president of the Miami Fertilizer Co., has been named chairman of the annual YMCA laymen's conference to be held Sept. 10 and 11 near Dayton, Ohio.

* * *

LUDLOW-SAYLOR WIRE CLOTH Co., St. Louis, has announced appointment of Robert E. Draper as sales representative for the Texas-Louisiana territory. In the same announcement Virgil R. Hogan was appointed to cover Alabama, Florida, Georgia, eastern Kentucky, Mississippi and central Tennessee.

* * *

KRAUSE PLOW CORP., Hutchinson, Kan., recently acquired exclusive manufacturing and sales rights for the *Liberty Liquid Fertilizer Hose Pump*, a product of Liberty Mfg. Co., Red Springs, N. C.

EDITORIAL

(From Page 31)

creasing emphasis on urea and a weakened position for nitrogen imports.

One result of the interaction of these various influences, he suggests, may well be increased participation by manufacturers of basic materials in the fabrication of complete fertilizers. All these suggested future trends merit study by the fertilizer manufacturer. Truly this is a changing, as well as an expanding industry.★★

HERE'S HOW

7 Great KILL Promotions Helped You Profit More With

HEPTACHLOR



KILL COTTON INSECTS

3,421,804 sales messages in farm magazines, newspapers, and over the radio—plus window banners, folders, and mobile displays...all told the cotton grower about Heptachlor, and its effectiveness against boll weevils and other cotton insects. This hard-hitting selling is still expanding making Heptachlor *a fast-mover* for dealers.



KILL CORN ROOTWORMS

More than 206,000,000 sales messages were beamed to Midwest farmers to tell the story that HEPTACHLOR KILLS CORN ROOTWORMS. Leading farm publications, radio stations and newspapers were used in the campaign. Wall charts, counter cards, and folders were used in the campaign to tie dealers directly into the selling effort. When the dust cleared, Heptachlor had moved into top position as the *leading soil insecticide.*



KILL ALFALFA WEEVILS

Alfalfa growers in the Northwest and Eastern states knocked out weevils with Heptachlor, as dealers cashed in on farm paper and newspaper ads. Editorials, wall posters, banners, mailers and folders combined with advertising to carry more than 970,000 sales stories to Western alfalfa states.

More than 949,000 sales messages were poured into Eastern alfalfa states through magazines and newspapers.



KILL GRASSHOPPERS

24,136,000 sales messages blanket the areas where hoppers are a major pest to repeat the story over and over—HEPTACHLOR KILLS GRASSHOPPERS. Campaign was carried through leading farm papers and radio stations with plenty of merchandising aids to cinch sales for dealers.



KILL POTATO WIREWORMS

More than a half-million Heptachlor messages in magazines and local newspapers told the story to potato growers about Heptachlor effectiveness against wireworms and other potato insects. Farmers produced high quality spuds and dealers made profits.



KILL ONION THRIPS

In Texas, California and Oregon, Heptachlor *effectiveness* is the theme for magazine, newspaper, radio and direct mail activities ...more than 872,000 messages! Dealers found that Heptachlor moved fast when growers got the low-down on Heptachlor for meeting the thrip menace.



KILL SOIL INSECTS IN FLORIDA

Heptachlor's effectiveness against wireworms and other soil insect damage to potatoes and sweet corn—that was the story told to Florida growers through newspapers, magazines and radio stations. 650,000 selling messages did the job as dealers profited from fast-moving *Heptachlor.*

In addition to the major programs outlined above, Heptachlor was widely promoted for many local applications. These thousands of additional sales messages were another important source of dealer profits from Heptachlor.

BUT THAT'S NOT ALL—MERCHANDISING AND PROMOTION BEHIND HEPTACHLOR IS BEING STEPPED UP FOR 1956 TO HELP YOU MAKE RECORD SALES AGAIN IN THE COMING SEASON. MAKE YOUR PLANS NOW TO CASH IN ON THIS EXPANDED PROGRAM.

REMEMBER, YOU'LL PROFIT MORE WITH HEPTACHLOR

VELSICOL CORPORATION

PETROLEUM DERIVED CHEMICALS — VELSICOL — SERVING BASIC INDUSTRIES

REPRESENTATIVES IN PRINCIPAL CITIES

General Offices and Laboratories, 330 East Grand Avenue, Chicago 11, Illinois

Suppliers' BULLETINS

New Liquid Fertilizer

Schrock Fertilizer Service, Congerville, Ill., has added "Liqui-Green with Leaftone" to its line of fertilizers. The new product contains nitrogen, phosphate and potash, along with the secondary and trace elements. "Leaftone" is a chemical additive designed to facilitate better leaf absorption for quicker response and to prevent burning.

•

Omega Issues Bulletin

Omega Machine Co., Div. of B-I-F Industries, Inc., Providence, R. I., has reprinted a revised edition of an article by Andrew A. Melnychuk on "Continuous Proportioning Equipment for the Fertilizer Industry." The 12 page bulletin contains technical data, installation photos and four new flow diagrams, showing the applications of Omega liquid and dry material chemical feeders in recently developed continuous processes.

•

Safety Council Book

The National Safety Council recently issued its 1955 Occupational Safety Services Guide which provides company safety directors with a complete catalog of the many and varied accident prevention aids available from the Council. The 68-page guide provides a list of Council periodicals, newsletters and a complete library of technical and administrative publications covering all phases of occupational accident prevention. Information on the subjects covered in the basic and advanced courses of the Council's Safety Training Institute is included also.

A full line of posters, films and booklets are available to sell safety to the man on the job.

Individual copies of Service Guide 2.1 may be obtained without cost by writing the National Safety Council, 425 N. Michigan Ave., Chicago 11, Ill.

•

Soil Test Film

A 22-minute film entitled "Soil Test" has been issued by Iowa State College. It was produced under the supervision of the college's agronomy department and is available for rental or sale.

•

Dorr-Oliver Bulletin

Dorr - Oliver Inc., Stamford, Conn., offers a new, twelve-page, two-color bulletin, "Dorr-Oliver Continuous Processing." It describes the characteristics, capacities and applications of equipment available to the process industries.

Unit operations are divided into three major groups. The first-finely divided solids suspended in liquids—includes agitation, classification, lime slaking, thickening, clarification, filtration, pumping, flocculation and digestion. Finely divided solids suspended in gases, second of the groupings, encompasses roasting, calcination, drying and dry classification. Ion-exchange methods of selective or complete removal of ionizable salts from solutions comprise the third group described in the bulletin.

•

Nitrogen Fertilizer Described

Grand River Chemical Division of Deere & Co., Tulsa, Okla., recently issued literature describing their product "Vitrea", which is composed of 45% nitrogen fertilizer from urea. The product is prilled into a bead-like shape, is reported non-caking and free flowing. It is suggested for use on rice, corn, sorghums, small grains, pastures, grass crops, cotton and sugar beets.

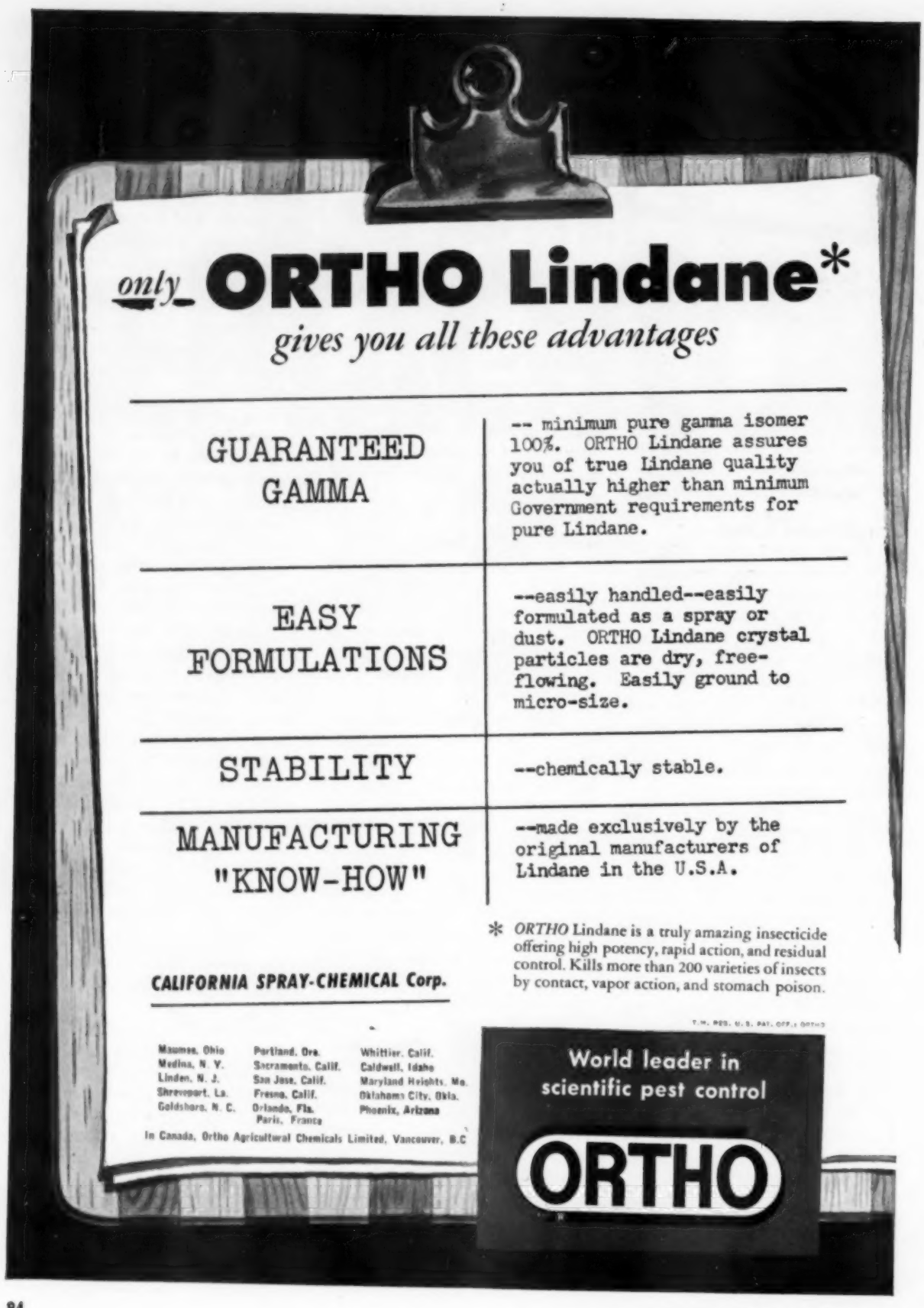
FLY CONTROL

(*From Page 53*)

Bruce and Decker (1947) found that in a period of 11 weeks milk production for herds receiving only the mediocre protection from flies afforded by the standard stock sprays then on the market declined 35 per cent, whereas in two series of herds where almost perfect control was attained through the use of DDT sprays, the decline in milk production over the same period was only 10 and 13.3 per cent respectively. They reported a high degree of inverse correlation between changes in milk production and fly abundance. It would appear that reduction in milk flow attributable to fly activity was progressive and the spread between milk production in treated and untreated herds increased as the season progressed. Then the residual treatment which caused an abrupt drop in fly populations induced a rise in milk production. The light daily treatments did not bring the flies under control for nearly a month and milk production continued to decline during this period. However, when the flies were finally eliminated and held under perfect control these herds out-performed all others. There were no completely untreated checks in this experiment, but by extrapolating trends up to the time of treatment, July 24, one might speculate that after August 1 even the herds receiving conventional cattle sprays may have derived considerable benefit from treatment.

Research in the last decade has also developed data to show that meat production may be increased through effective fly control. Bruce and Decker, working in southern Illinois, found that steers protected from tabanid attack over a 28-day period gained 20 to 30 pounds per animal more than unprotected steers in a comparable adjacent pasture. They also show a good inverse correlation between weight gains and tabanids per animal.

By studying milk production records (1924-1951) one finds trends that have considerable in common


only ORTHO Lindane*
gives you all these advantages
GUARANTEED GAMMA
-- minimum pure gamma isomer 100%. ORTHO Lindane assures you of true Lindane quality actually higher than minimum Government requirements for pure Lindane.
EASY FORMULATIONS
--easily handled--easily formulated as a spray or dust. ORTHO Lindane crystal particles are dry, free-flowing. Easily ground to micro-size.
STABILITY
--chemically stable.
MANUFACTURING "KNOW-HOW"
--made exclusively by the original manufacturers of Lindane in the U.S.A.
* ORTHO Lindane is a truly amazing insecticide offering high potency, rapid action, and residual control. Kills more than 200 varieties of insects by contact, vapor action, and stomach poison.
CALIFORNIA SPRAY-CHEMICAL Corp.
Maumee, Ohio
Medina, N. Y.
Linden, N. J.
Shreveport, La.
Goldsboro, N. C.
Portland, Ore.
Sacramento, Calif.
San Jose, Calif.
Fresno, Calif.
Orlando, Fla.
Paris, France
Whittier, Calif.
Caldwell, Idaho
Maryland Heights, Mo.
Oklahoma City, Okla.
Phoenix, Arizona
In Canada, Ortho Agricultural Chemicals Limited, Vancouver, B.C
World leader in scientific pest control
ORTHO

with the historic development and usage of cattle fly sprays. Attempts to gather reasonably accurate data on stock spray sales were only partially successful. Little or no data were available for years prior to 1934, but five major companies in busines during the period 1935-1944 supplied sales data for that period on a confidential basis. When summarized and compared with milk production records for the same period, the two sets of data were unbelievably similar. Certainly it would be presumptuous to claim a cause and effect relationship, but that possibility cannot be wholly ignored. The implication is even more striking when one notes the constant upward trend after the introduction of DDT in 1945.

Despite the conflicting opinions of some eminent entomologists and dairy scientists, on the basis of all available data, the writer can only conclude that under normal field conditions biting flies do adversely affect both milk and meat production. I strongly suspect—in fact, I firmly believe—that when and if we ever get sufficient data together, they will show conclusively and beyond any shadow of doubt that reduction in meat or milk production will be in direct proportion to some appropriate measure of exhaustion or devitalization of the animal concerned and traceable to loss of blood, over-exertion, etc. Thus, the extent of such losses for any herd, in any given season or area, will be dependent upon the length of the season, the density of the fly population and the species involved.

We now have fly sprays that will effectively control flies without injury to livestock, and their proper use can and should be one of the most profitable steps in animal production.★★

RESIDUE CALCULATIONS

(*From Page 37*)

organic phosphates, metallic dithiocarbamates, dinitro compounds) the tolerance for the total residues shall be the same as that for the chemical having the lowest numerical tolerance in its class. Thus, a residue of dieldrin (tolerance 0.1 p.p.m.) and toxaphene (tolerance 7.0 p.p.m.) would have to meet an organic chlorine tolerance equivalent to .1 p.p.m. of dieldrin (0.056 p.p.m. of Cl).

4. If ingredients are in the same class and there are methods permitting quantitative determination of each residue.

The quantity of combined residues within the tolerance is calculated on a percentage basis. For example, consider a mixed residue of 8 p.p.m. methoxychlor (tolerance 14 p.p.m.) and 2.0 p.p.m. DDT (tolerance 7 p.p.m.). The percent of the tolerance for each chemical is calculated and summed. The sum of the percentages shall not exceed 100. Thus:

$\frac{8}{14} \times 100 = 57.2\%$ of methoxychlor residue tolerance

$\frac{2}{7} \times 100 = 28.6\%$ of DDT residue tolerance

85.8% of mixture tolerance

5. If the chemicals of a mixed residue are in the same class and there are methods for the quantitative determination of one or more, but not all, of the residues, the amount of the determinable residues shall be deducted from the total residue and the remainder shall have the same tolerance as that having the lowest numerical tolerance in that class. For example, consider a food product having an organic chlorine residue of 3 p.p.m. Further analysis shows the sample to contain 2.2 p.p.m. of DDT equivalent to 1.10 p.p.m. of chlorine and 6 p.p.m. of methoxychlor equivalent to 1.84 p.p.m. of chlorine. The total DDT and methoxychlor residue would equal 2.94 p.p.m. of chlorine and the remainder of the chlorine residue (0.06 p.p.m.) would have a tolerance of 0.1 p.p.m. (lowest numerical tolerance of the organic-chlorine class). The percentage of the tolerance for each chemical would be calculated and summed as in example 4. Thus:

$\frac{2.2}{7} \times 100 = 31.4\%$ of DDT residue tolerance

$\frac{6}{14} \times 100 = 42.8\%$ of methoxychlor tolerance

$\frac{0.06}{0.1} \times 100 = 60.0\%$ of chlorine residue tolerance

134.2% of tolerance

Since the sum of the percent of tolerance exceeds 100, the residue would be considered in excess of the tolerance.★★

CHEM. FOR AGRICULTURE

(*From Page 49*)

agriculture. Part of the difference has, of course, been made up by industrial andmilitary outlets for nitrogen, but on the other hand, these are not expected to increase proportionately faster than agricultural nitrogen uses. As a result, excess capacity for ammonia and for some of its derivatives has been created, and producers are operating at less than capacity levels during portions of the year. With the continued increase in plant capacity which is now envisioned, this oversupply condition may become somewhat more acute. Many companies holding some advantage, such as geographical position, low-cost raw-material source, or captive market, are entering the field and removing a portion of the growth potential which might otherwise be realized by the present producers. The attractiveness of this field to new entrants is, of course, influenced by the satisfactory return on investment which may be realized at present prices for nitrogen products, and by the relative ease with which a company can acquire the necessary technological position.

Regionality is perhaps one of the most important influences on new ammonia plant construction. Many of the newer ammonia plants have been concentrated in the Southwest, where natural gas is more readily available and lower-priced than in other portions of the country. If one considers only natural-gas-type plants, and assumes that the cost of gas increases

1¢ for each 100 miles from the point of origin and that the consumption of gas amounts to about 50,000 cubic feet per ton of ammonia, the increase in cost of ammonia as one moves 100 miles from the gas source is 50¢ per ton, or for 1000 miles, it is $5 per ton. However, plants located some distance from the gas source enjoy protection because of the freight differential, and this advantage more than offsets the raw-material-cost disadvantage. For typical plants located 500-800 miles from the Gulf Coast, the net advantage amounts to $10-$15 per ton of ammonia.

One additional factor which influences the location of new ammonia plants is the adoption of new types of raw materials for its manufacture. Actually, there are already eight different types of raw material used for ammonia manufacture. Particular attention is now being given to the use of by-product hydrogen from catalytic reforming. A plant using this material may have a $10-per-ton cost advantage over plants utilizing natural gas. While the needs for hydrogen within the petroleum-refining industry may ultimately exhaust this supply, there is considerable interest in its utilization for ammonia manufacture at this time. There is also the possibility of wider use of the Texaco oil-oxidation process; a plant based on this process is currently being installed at Searsport, Maine, and others are under active consideration. This process, of course, allows greater geographical flexibility and permits manufacture of ammonia where residual or crude oil can be delivered economically.

There do not appear to be any important trends in the manufacture of other prime nitrogen materials with exception of ammonium sulfate. This material faces a somewhat weakening market, because of its relatively low nitrogen and the general trend towards manufacture in mixtures by overacidulation and subsequent ammoniation. On the other hand, this trend will probably have its principal effect on the production of synthetic sulfate rather than by-product sulfate from the steel mills. Imported nitrogen undoubtedly faces a gradual decline as domestic production is marketed more aggressively, and as farmers' preferences tend to shift to some of the higher-analysis materials rather than Chilean nitrate.

Among the nitrogen derivatives, considerable emphasis is being placed upon the manufacture of urea, which has a higher analysis than other forms of nitrogen, and also diversified markets outside of the agricultural field. While it presently is more costly per unit of contained nitrogen, there are prospects of its becoming more nearly competitive.

Anhydrous ammonia, and for that matter, all other forms of liquid nitrogen applied directly to the soil, have shown the most startling growth in recent years, and will undoubtedly continue in those areas where the terrain, soil conditions, and economic factors are in their favor. Research

Hardinge CONSTANT-WEIGHT FEEDERS
for Fertilizer Blending



Three Hardinge Constant-Weight Feeders for proportioning raw materials in a uniform blend onto a moving conveyor.

Many internationally known fertilizer manufacturers use the Hardinge Constant-Weight Feeder for their blending processes. Users of the Hardinge Constant-Weight Feeder for accurate fertilizer blending and mixing include:

International Minerals and Chemical Company
Farm Fertilizers, Incorporated
Stauffer Chemical Company
Sugar Beet Products Company
Baugh Chemical Company
American Agricultural Chemical Company
Smith-Douglass Company
Farm Belt Fertilizer Company
Virginia-Carolina Chemical Corporation
Comptoir des Phosphates Tunisiens (Tunisia)
The Fertilizer Plant, Incorporated (Iceland)

Give us pertinent details of your fertilizer ingredients and characteristics when writing for additional information. Bulletin 33-E-57.

HARDINGE
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YORK, PENNSYLVANIA • 240 Arch St. • Main Office and Works

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groups in the industry are examining ways in which nitrogen and other plant food materials may be fixed in even higher-concentration forms, and this may be one of the most interesting long-term opportunities in the field.

In the phosphate market, emphasis has been placed upon the higher-analysis products, especially triple superphosphate. There are now a total of 16 plants, mostly in Florida and the Intermountain area, and capacity has grown to over 1.7 million tons. Even when production reaches that level, however, triple superphosphate would account for less than 40% of the total P_2O_5 consumption in fertilizers. Despite the fact that use of triple superphosphate is economically justified in virtually all regions of the country, general reluctance to accept the concept of higher-analysis materials will probably delay its acceptance in the Southeast.

More readily available forms of phosphate, such as ammonium phosphate, may find wider markets as phosphate usage develops in the West, where water solubility is more important; there is now increasing appreciation of the importance of solubility, because recent agronomic results indicated better response to water-soluble forms of phosphate than to citrate-soluble forms.

In the potash field, the industry has also seen the entrance of a number of new producers, although this activity is relatively more controlled because of the limitations in raw-materials supply. Two new groups, one formed by Pittsburgh Consolidation Coal and Freeport Sulfur under the name of National Potash, and the other by National Farmers Union, Kerr-McGee, and Phillips Chemical under the name Farmers Chemical Resources Development Corporation, are the most recently announced entrants. Potash consumption in agriculture has grown almost as rapidly as that of nitrogen, also with increased emphasis upon material applied directly to the soil in the Middle West. Imports continue to be a threat in the Eastern United States, although consumption in Europe and other parts of the world has been increasing at such a rate that import activity has not been so great recently.

Considerable interest has been generated by the announcements of the potash deposits in Saskatchewan, which may offer an interesting potential because of their accessibility to some of the corn and wheat belt states, even though the deposits occur at considerable depth. Active development and drilling programs are under way in this area by several groups.

The economic-poisons industry displays many characteristics which are common to fertilizers, but others which are considerably different from those inherent in the fertilizer industry. Among the latter is the fact that the products demonstrate considerable cyclicality, occasioned by varying weather conditions and levels of insect infestation. As yet, most economic poisons are not used as preventives, but rather as cures after infestation develops, or at least after

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there is some evidence that infestation is about to develop. There are, of course, some exceptions such, as in the fruit industry, where complete protection is essential, regardless of the level of infestation.

The economic-poisons field has now grown to the level where expenditures by farmers amount to an estimated $450 million, or about 40% of the total currently expended for fertilizers. About $200 million of this total is for insecticidal materials, and the remainder for veterinary products, fungicides, weed killers, plant hormones, and defoliants.

The maximum potential for economic poisons may be gauged from the fact that losses due to plant disease, animal disease, insects, and weeds total about $13 billion, mostly in the noninsecticidal category. It is notable that less than 10% of the expenditure for economic poisons goes for weed killers, even though the estimated loss due to weed damage amounts to nearly 30% of the total crop loss.

Return to farmers from application of economic poisons has not been as definitely gauged as it has for fertilizers, but in a few selected tests, the return on investment has amounted to between $5 and $20 per dollar spent for most of the principal agents employed to minimize crop loss. This relationship compares favorably with the return experienced in the fertilizer industry, and again demonstrates the potential for growth in use of economic poisons as further demonstration work and development programs are undertaken.

Because of the cyclicality and general overproduction in the field, profitability in recent years has been severely limited, and inventory control has been an important problem to the industry. Some progress is being made to offset these problems, and in addition, considerable emphasis is being devoted to the development of specialties which are not so subject to competition. While development work leading to successful commercialization of a specialty economic poison is very costly, the return may be large, despite generally poor economic conditions in the industry. Just as in the fertilizer industry, the economic-poisons field offers the market researcher a major challenge in uncovering and appraising markets for these materials.★★



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COTTON LEAFWORM

(*From Page 43*)

insecticides were applied. Subsequent records were taken 24 hours after treatment.

Preliminary laboratory and field tests indicate that 0.25 pound of parathion or 0.33 pound of endrin per acre is effective for control of this pest.★★

CELERY BLIGHT

(*From Page 58*)

Perhaps more significant, however, was the effect of these two materials in mixture. The combination appeared more effective than either material used alone, although it was not significantly better than the straight

streptomycin - Terramycin material (compare Schedules E and B).

The question naturally arises as to the type of action involved in this mixture. It appears safe to conclude that these materials, i.e., streptomycin-Terramycin and Copper A, were compatible. Also, the data suggest, although they do not show statistically, that the combination has an additive effect in respect to reducing the incidence of bacterial blight. If the effect is additive, the question then arises as to whether the action should be classed as synergism. Horsfall would call it supplementary synergism. There was no indication of true synergistic action (the total effect greater than the sum of the two effects taken independently). These data do not preclude this possibility, however, because of the high degree of effectiveness of each material when used alone. Further study is needed.

The results indicate, nevertheless, that with the proper mixture of streptomycin-Terramycin and copper compounds (in other limited tests tribasic copper sulfate showed the same effect in the mixture), adequate control of bacterial blight of celery in the seedbed can be obtained with weekly applications, instead of semi-weekly as is necessary where a straight copper program is followed.★★

BATTELLE INSTITUTE

(*From Page* 42)

tution. Too, the private institutes can often bring to bear on a problem industrial experiences and viewpoints as well as scientific disciplines that are not commonly found in public agricultural research organizations.

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AGR. EMULSIFIERS

(*From Page* 36)

on storage. This results when the emulsifier is modified to give a more favorable hydrophile-lipophile balance as the result of the reactions occuring during the course of aging. All emulsifiers which we have examined eventually give poorer performance, however.



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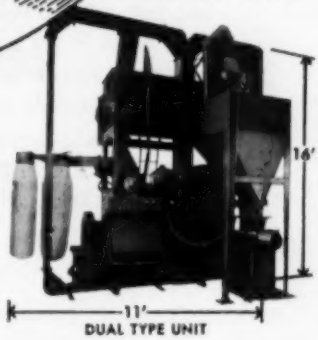
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No quantitative tests have been developed. A rating of excellent, good, fair or poor is assigned for each formulation.

Viscosity

Under all temperatures likely to be encountered in storage and handling, the emulsifier must be sufficiently low in viscosity to permit transfer by pumping or pouring. The viscosity —temperature relationship may be gauged by standard methods.

Temperature Sensitivity

To allow long term comparisons among samples, all of our emulsion stability tests are conducted at 25°C. In addition, the temperature coefficient of emulsion stability is determined for any potential candidates. Some typical variations in the performance of an experimental emulsifier in 6# Toxaphene-kerosene are shown in Figure 5. Acceptable performance over the range of conditions encountered in use is required.

Other Requirements

Certain other requirements will be mentioned only briefly. The emulsifier must not contribute phytotoxicity to a pesticide (except for herbicides, of course). Testing of this requires observation in actual application trials. Reemulsification may be required where an emulsion has been allowed to settle. Examination is made by a suitable alteration of the initial stability measurement. Clarity, color, odor, and flammability are of importance in some cases.

Conclusion

Since no surfactant combination will meet all desiderata as outlined, suitable compromises must be made. In this area the experience and ability of the chemist and his sales representative are paramount, for this is a question of judgement which cannot be reduced to quantitative test.★★

The authors express appreciation to S. R. Domanski, A. Hauser, R. Freynik and J. Huey for their contributions to the development of this work.

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(1) *Chemical Week*, October 2, 1954, page 93.

(2) Supplied by A. H. Thomas Company, Philadelphia, Pa.

(3) Griffin, W. C., and Behrens, R. W., *Anal. Chemistry*, 24, 1076-77 (1952).

(4) Griffin, W. C., J. Soc. Cosmetic Chemists, I(5), 311-326 (December, 1949) V(4), 1-8, (December, 1954)

(5) Sparr, B. I., and Bowen, C. V., *J. Agri. & Food Chem.*, 2, 871 - 872 (1954).

FERTILIZER UREA

(From Page 51)

phosphate, dicalcium phosphate, and water according to the equation:

$$Ca(H_2PO_4)_2 \cdot H_2O + CO(NH_2)_2 \rightarrow H_3PO_4 \cdot CO(NH_2)_2 + CaHPO_4 + H_2O \quad (1)$$

Urea phosphate also can be prepared by the reaction of urea with phosphoric acid. Another typical compound of urea with an acid is that of urea nitrate, HNO_3: $CO(NH_2)_2$, which is formed by the reaction of urea with nitric acid.

Urea reacts with formaldehyde to form numerous reaction products some of which are used in the plastics industry and others in the fertilizer industry. Those suitable for fertilizer use have a urea-formaldehyde mole ratio greater than unity and contain 38% or more of nitrogen in more or less slowly available form.

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Material	Mixture No. 1	Mixture No. 2
	-lbs./ton-	
Urea	—	300
Potassium nitrate	480	—
Ammonium sulfate	300	146
Ammoniating solution[1]	100	—
Ammoniating solution[2]	—	157
Ammonium phosphate (20% N)	390	—
Triple superphosphate	300	710
Potassium chloride	60	400
Dolomite	160	187
Conditioner	210	100
Total	2000	2000

[1]Contained total nitrogen 40.6, ammonium nitrate 65, neutralising ammonia 21.7, and water 13.3%.
[2]Contained total nitrogen 45.3, urea 43.1, neutralising ammonia 23.5, ammonium carbamate 16.4, and water 17%.

TABLE V. Fertilizer Formulas Grade 12-16-12

Behavior of Urea in Processing, Storage

UREA is available both in solution and in the solid state for use in mixed fertilizers. Types of urea ammoniating solutions now in use are urea-ammonia, urea-ammonium carbamate-ammonia, urea-formaldehyde - ammonia and ammonium nitrate-urea-ammonia solutions. The past use of urea in the experimental and commercial processing of mixed fertilizers furnishes considerable data that can be applied to present-day granulation methods for the commercial production of urea - containing products.

Effect of Solubility

While urea is somewhat less soluble than ammonium nitrate (Table I), it provides a greater volume of solution per unit weight of water, than does an equivalent quantity of ammonium nitrate (Table II). A definite volume of liquid is required to promote optimum agglomeration of solids during the process of granulating mixed fertilizers. The increase in volume of liquid with increase in amount of urea and (or) ammonium nitrate in mixed fertilizers is utilized to advantage in granulating mixtures at low moisture content, thus avoiding the necessity of removing large amounts of moisture in the drying step of the process. Limitations regarding the use of urea and ammonium nitrate in the same mixture have not been definitely established, but the potential effect of this combination of salts on the liquid phase of a mixed fertilizer can be estimated from the data given in Table III. For example, with the salt mixture containing 46% urea and 54% ammonium nitrate (Table III) it is apparent that 1 pound of water at 86° F. will dissolve 7.19 pounds of urea and 8.45 pounds of ammonium nitrate to give a solution containing 15.64 pounds of salt and having a volume approximately 12 times that of the original pound of water.

The effectiveness of urea in promoting granulation at low moisture content is illustrated by the results of granulation tests on mixtures formulated as shown in Table V. Both mixtures agglomerated at 55-60° C. (131-140° F.) and yielded 87% of 6- to 20-mesh product, but Mixture 1 required 15% of moisture for optimum agglomeration, while Mixture 2 required only 6%. The granulation temperature of these mixtures was considerably lower than that normally used in granulating high-analysis mixed fertilizers. There was no apparent decomposition of the urea component.

Effect of Temperature

The heat developed during storage of ammoniated superphosphate, or of mixtures containing it, may cause the urea present to decompose or hydrolyze by reaction with various components of the mixture if temperatures in excess of 50° C. (122° F.) exist for several days. The carbon dioxide formed during the decomposition escapes from the mixture, but the ammonia is in general retained by the acidic constituents except on prolonged heating at higher temperatures. All of the urea in a urea-superphosphate mixture is hydrolyzed after a few hours at 100°C. (212°F.). Mixtures of double superphosphate

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and urea behave in a similar way. The hydrolysis of urea appears to occur by reaction with free water, water of crystallization, or with the water of constitution of several common fertilizer materials.

Tests on a number of complete mixed fertilizers have shown that more than 50% of the urea in the samples decomposed the first week at 85°C. (185°F.). These data indicate that, while decomposition begins at relatively low temperatures, any appreciable degree of decomposition may require hours, or possibly days. Therefore it is conceivable that high processing temperatures might be imposed on such mixtures for a short period of time without appreciable decomposition of the urea component. The temperature developed in many ammoniation-granulation processes is sometimes in excess of 212° F., especially when sulfuric acid is used in combination with ammoniating solutions. Drying of the product may elevate its temperature even higher. Further investigations are needed on such methods of processing urea mixtures in order to establish the maximum processing temperature that can be attained without decomposition of the urea component. Even though it may be possible to attain relatively high temperatures during the short period of processing, cooling of the ammoniated urea mixture prior to bulk storage seems essential for its stability in the storage bin.

Effect Of Hygroscopicity

The presence of solid urea in admixture with other fertilizer salts (Table IV) tends to make the mixed fertilizer more hygroscopic. Mixtures 1 and 2 (Table V) had initial moisture contents of 3.0 and 4.0% respectively. In laboratory tests at 30° C. and 60% relative humidity Mixture 1 containing no urea absorbed no moisture, while Mixture 2 containing 368 pounds of urea per ton absorbed 13% water in 10 days. Results of bag-storage tests in burlap bags agreed with those of the laboratory tests. In commercial practice the hygroscopic mixture must be protected by a high-grade moisture-resistant package.

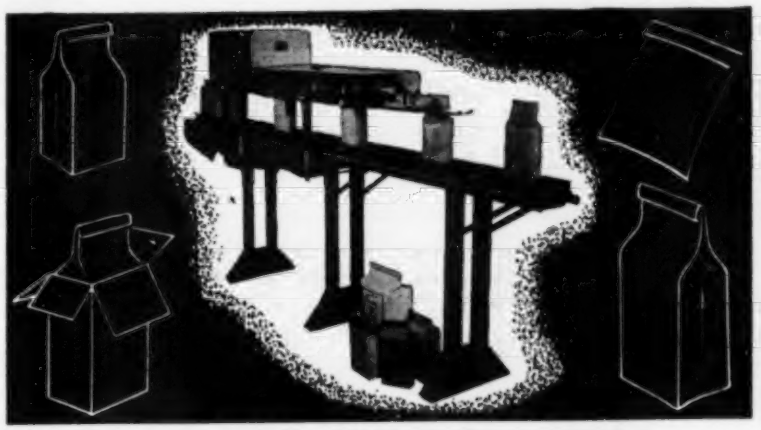
Effect of Chemical Reactions

CONDITIONS for preparation of some of the urea complex compounds are well-known. For example, the compound $Ca(NO_3)_2 \cdot 4CO(NH_2)_2$ (Table IV) is made by intimately mixing calcium nitrate and urea in the proper proportion and evaporating the resulting pasty mass to dryness. The commercial product, known as Calurea, contains 34% nitrogen. Its domestic use is now of minor importance chiefly because of the high unit cost of nitrogen in this form. The formation of such compounds from urea and the inorganic salts in mixed fertilizers will depend largely on conditions during processing. For example, urea phosphate forms when a saturated aqueous solution of urea is stirred at room temperature for 90 minutes with an excess of monocalcium phosphate monohydrate. It can be formed also by mixing the relatively dry salts in equi-molecular proportions and keeping the mixture at a temperature of 30° C. and a relative humidity of 64.5% for several days. Thus, its formation seems likely in non-ammoniated superphosphate mixtures containing urea but not in ammoniated mixtures, because ammoniation converts the monocalcium to dicalcium phosphate which does not appear to react with urea to form urea phosphate.

Urea - formaldehyde reaction products may be present in mixed fertilizers to provide slowly available nitrogen. Such products may be added to the mixture, or the required urea and formaldehyde may be added separately or as mutual constituents of the ammoniating solution.

Excepting reactions, such as those between urea and formaldehyde which produce a specific effect on the fertilizer mixture, the reactions resulting in the formation of urea complexes in mixed fertilizers are of less

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Conditioning Effect

There is growing evidence that the branching, tree-like growth of crystals of ammonium chloride is largely responsible for the caking of many mixed fertilizers. The crystallization is caused by decrease in free moisture content or in temperature of the mixture during storage. The dendritic or branched structure of the ammonium chloride crystal is modified to form cubes in the presence of one part by weight of urea to 6 parts by weight of ammonium chloride. On the assumption that cubical crystals of ammonium chloride produce a weaker binding between particles of a mixed fertilizer than do the normally branched crystals, a series of laboratory caking tests was made on a non-granular 10-10-10 reference mixture with and without the addition of urea. The mixture contained ammonium sulfate 520, ammonium nitrate 125, ammoniating solution (40.6% N) 130, superphosphate 806, triple superphosphate 81, and potassium chloride 338 pounds per ton. The crushing strengths of fertilizer cakes produced with urea used at rates of 0, 20, and 50 pounds per ton of final mixture, were respectively 249, 181, and 129 pounds per square inch. While the urea did not eliminate caking, the addition of 50 pounds per ton of mixture produced a 48% reduction in crushing strength of the fertilizer cake. It was a more effective anti-caking agent for this type of mixture than most of the conventional inert conditioning agents used at twice this rate in similar tests.

Summary

ALTHOUGH recognized as a constituent of liquid manure since the 18th century, urea for fertilizer use has gained commercial significance only within the past 25 years. Increasing domestic production from ammonia and carbon dioxide has stimulated an already rising interest in the use of urea as a source of fertilizer nitrogen. Its properties and its behavior in mixed fertilizers during processing have been discussed with the object of bringing attention to some of the processing and storage problems and some of the potential benefits connected with its incorporation in mixtures.

Acknowledgment

Grateful acknowledgment is made to Merlin J. Guinard and Herbert F. Rapp who kindly assisted with the solubility measurements.★★

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FERTILIZING RESIDUES

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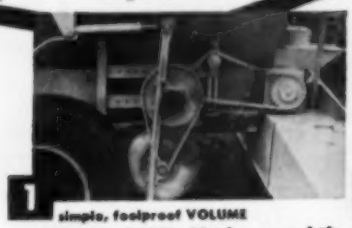
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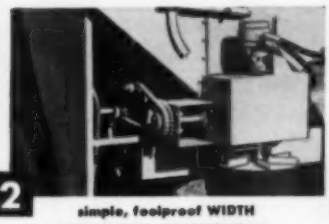
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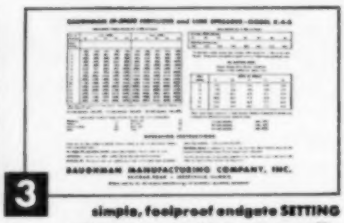
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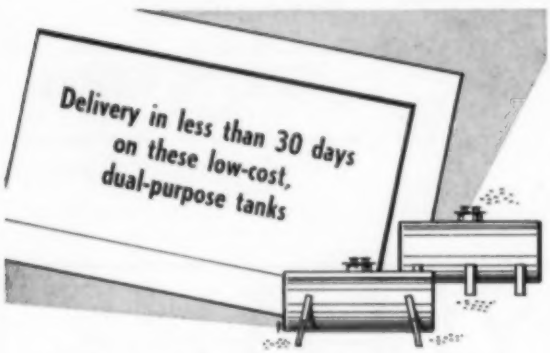

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(*From Page* 46)

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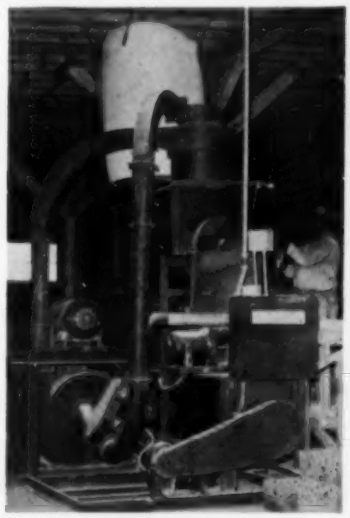
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2,700,605. Process for Making A Fluid Phosphate Fertilizer Slurry Suitable for Pelletizing. Patent issued Jan. 25, 1955 to Floyd B. Hornibrook, Piedmont, Calif., assignor to Best Fertilizers Co., Oakland, Calif., a corporation of California.

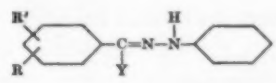
The process of pelletizing phosphate fertilizer that comprises the steps of digesting phosphate rock in an aqueous solution of an inorganic salt and sulfuric acid having an acid concentration not exceeding about 30° Bé. and from about 8% to about 30% of said inorganic salt by weight of the mix and at a temperature of from about 210° F. to about 225° F. until the water content after ammoniation is from about 28% to about 32% by weight of the mix, ammoniating the reaction product until the acids are substantially neutralized and finally pelletizing the ammoniated product at substantially said temperature, the said inorganic salt being one of the group ammonium sulfate, ammonium nitrate, potassium sulfate, potassium nitrate, ammonium biphosphate.

2,702,966. Process for the Improvement of Soils. Patent issued March 1, 1955, to Thomas Boyd, Springfield, Mass., assignor to Monsanto Chemical Co., St. Louis, Mo., a corporation of Delaware.

A process for the improvement of soil containing a compound taken from the group consisting of the oxides, hydroxides and carbonates of alkaline earth metals, which process comprises incorporating a substantially water-insoluble pulverulent polymer of acrylonitrile into the soil and thereafter wetting down the treated soil with water.

2,703,751. Herbicidal Compositions. Patent issued March 8, 1955, to Dexter B. Sharp, Vandalia, Ohio, assignor to Monsanto Chemical Co., St. Louis, Mo., a corporation of Delaware.

A herbicidal composition comprising an oil-in-water emulsion containing a phytotoxic concentration of a phenylhydrazone having the formula in which R



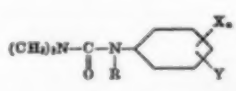
and R' are selected from the class consisting of hydrogen, chlorine, alkyl radicals of 1 to 3 carbon atoms and alkoxy radicals of 1 to 3 carbon atoms and Y is an alkyl radical of from 1 to 3 carbon atoms.

2,704,243. Method of Defoliation. Patent issued March 15, 1955, to Frank J. Seibert, Bound Brook, N.J., assignor to Chipman Chemical Co., Inc., Bound Brook, N.J., a corporation of New York.

A method of defoliating cotton and other plants which comprises applying thereto in the form of an aqueous solution and at a rate of 2 to 10 pounds per acre, a composition consisting essentially of 25 to 60% of sodium chlorate and 75 to 40% of a sodium polyborate of the general formula $Na_2O.(B_2O_3)_x$, where x is a number from 4.16 to 7.

2,704,245. Pesticidal Tetra-Substituted Ureas. Patent issued March 15, 1955, to Norman E. Searle, Wilmington, Del., assignor to E. I. du Pont de Nemours and Co., Wilmington, Del., a corporation of Delaware.

A tetra-substituted urea represented by the formula



where R is an alkyl radical up to two carbon atoms, X is halogen, n is a positive integer up to three, and Y is selected from the group consisting of hydrogen and alkyl of 1 to 4 carbon atoms, the aromatic substituent having hydrogen on at least one of the nuclear carbons ortho to the nuclear carbon to which the urea nitrogen atom is linked.

2,705,213. Composition for Control of Mite and Insect Pests. Patent issued March 29, 1955, to Eugene E. Kenaga, Midland, Mich., assignor to the Dow Chemical Co., Midland, Mich., a corporation of Delaware.

A composition for the control of mite and insect pests comprising as active toxic ingredients from 0.009 to 25 parts by weight of 1,2,4,5,6,7,8,8-octachloro-4,7-methano-3a,4,7,7a-tetrahydroindane in mixture with 1 part of 4'-chlorophenyl 4-chlorobenzene sulfonate, the active toxic ingredients of such composition being mutually activating.

2,705,694. Insecticidal Compositions Comprising Diethyl Thiophosphoric Acid Disulfide. Patent issued April 5, 1955 to Jeffrey H. Bartlett, Westfield; Harry W. Rudel, Roselle Park, and Elmer B. Cyphers, Cranford, N. J., assignors to Esso Research and Engineering Co., a corporation of Delaware.

An insecticidal composition comprising diethyl thiophosphoric acid disulfide as the active ingredient admixed with an emulsifying agent which lowers the surface tension of water and thereby promotes aqueous emulsions of the active ingredient.

2,705,727. Synthesis of Ureas. Patent issued April 5, 1955 to Peter Joseph Graham, Kennet Square, Pa., assignor to E. I. du Pont de Nemours and Co., Wilmington, Del., a corporation of Delaware.

Process of synthesizing a urea which comprises intimately contacting an aqueous solution of an acid salt of a compound selected from the group consisting of ammonia, hydroxylamine, hydrazine and organic amines having hydrogen directly attached to nitrogen, and in which acid salt and acid has a pHa of not more than 4.7, with a synthetic polymeric water-insoluble quaternary ammonium anion exchange resin charged with cyanate ion, said acid being of sufficient strength to free the cyanate ion and being otherwise inert.

2,706,147. Process For Ammonia Manufacture. Patent issued April 12, 1955 to Peter L. Paull, Norwalk, Conn., assignor to Texaco Development Corp., New York, a corporation of Delaware.

A process for preparing ammonia which comprises reacting a carbonaceous fuel with oxygen and manganese oxide at a temperature above 1,800°F. whereby a product gas comprising mainly carbon monoxide and hydrogen is formed and said manganese oxide is converted to metallic manganese, separating said manganese from said product gas, reacting manganese with nitrogen at a temperature of 1,000 to 2,200°F. and under pressures of 100 to 4,000 p. s. i. g. to form manganese nitride, reacting said manganese nitride with water to yield manganese oxide and ammonia, separating manganese oxide from water and ammonia and recycling said manganese oxide to the reaction zone to react with said carbonaceous fuel and oxygen.

In Publication...Available September 15

HANDBOOK
OF
INSECTICIDE DUST DILUENTS AND CARRIERS

Revised Edition, Edited and Prepared by

D. E. Weidhaas and J. L. Brann, Jr.

Cornell University, Ithaca, N. Y.

THE original publication "Properties and Commercial Sources of Insecticide Dust Diluents and Carriers" prepared by T. C. Watkins and L. B. Norton of Cornell University has been brought up to date and completely revised by Drs. Weidhaas and Brann. The new edition contains commercial information as well as data obtained in research conducted at Cornell University. A short discussion of the structure of each of the major groups and their effect on the physical and chemical properties of the group gives the readers a basic knowledge of the differences between types of materials.

The book is bound in a flexible leatheroid cover, for handy, practical use. It will be available about September 15th. Orders mailed in now will receive first consideration.

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Tripolite	Pyrophyllite
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Tale Ends

OLD timers at attending the annual NAC fall convention at Spring Lake should be cautioned to prepare for a shock when they check into the Essex and Sussex a month hence. First, the perennial manager, C. S. Krom, has retired. Second, the cocktail lounge has been refurbished, extended, and as we get the story, now boasts a band and dance floor. Bet the "Lady in Black" still presides, though, and sends stragglers along into dinner when she feels they have reached their capacity for the moment.

AC

Those familiar with the agricultural press lifted their eyebrows with amazement last month when they read of reported sale of the "Country Gent" to Farm Journal Inc. Before its sale by Curtis, June 1, the name of the respected 124-year-old "Country Gentleman", oldest existing agricultural magazine in the country, had been changed to "Better Farming". But before the process of digestion has even had a chance to get started comes word that the Federal Trade Commission is determined to throw a monkey wrench into the proceedings. "Farm Journals" has just been whacked with an order to appear before the FTC September 20, charged with violation of the antimerger provisions of the Clayton Antitrust Act, and called to explain why it should not be required to get rid of the publishing property it acquired. The complaint says that acquisition of "Better Farming" would give "Farm Journal" 51% of circulation, and "51% plus" of advertising revenues of the six leading farm magazines.

AC

Hold your hats boys, here we go again! Perry W. Mader of Sou-Tex Laboratories, Bay City, Texas, has went and done it. According to a press release from C. E. Arthur, program director of radio station KIOX, Bay City, Mr. Mader, "scientist of note" from Alabama, discoverer of the Mader formula used in the production of liquid fertilizer, has recently made an even more astounding discovery, described by Mr. Arthur as "the most astounding formula ever realized by chemists," — the "Mader nitrogen-free formula". In the words of Mr. Arthur, "this formula when applied to the soil lets the plants receive nitrogen which the formula extracts direct from the air and deposits the nitrogen in the ground near the roots of the plant."

We like to keep such items on the brief side, but Mr. Arthur's prose intrigues us. Can't refrain from quoting further: "The general public doesn't know of this formula as yet, but the fertilizer manufacturers are very excited about the great possibilities. Well known scientists say it will revolutionize the fertilizer industry. This nitrogen free formula, using the reverse principle of the hydrogen bomb, extracts nitrogen from the air by using cobalt. This means that this patent new fertilizer can be manufactured, furnishing the same amount of nitrogen to the plant life at one-fifth the cost of fertilizer now being used.

Sound the tocsin. Ring the alarm. Fertilizer mfrs., attention. To the hills men, the dam has burst.!

AC

And along with this note of gloom for the fertilizer trade comes a companion piece for insecticide manufacturers. Devin-Adair, 23 E. 26th St., New York, will publish in November a new volume designed to scare the pants off anyone who is reckless enough to keep on eating. Titled "Your Daily Poison", it is authored by Leonard Wickenden. And if the title alone doesn't indicate clearly what to expect, we might add that it will carry an introduction by that well known medical figure, Dr. Morris Biskind.

AC

Although no definite announcement or decision was made on the 1957 meeting of the Pacific Coast branch of the Entomological Society of America, members were asked to comment on desirability of holding the 1957 convention in Hawaii. No further comment.



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